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A BANNER EXPORT YEAR.

Unless conditions change suddenly, in a way not to be expected, it is plain that 1903-4 will prove a banner export year. While there was in May quite a falling off in agricultural exports, there was a gain in manufactures, and the totals for the eleven months, including May, are $1,344,253,299, or nearly fifty millions above last year and eighty more than 1902. It is encouraging to note equally in the totals a gain for manufactures, the amount being $410,536,408, as compared with $373,845,543, or an increase of nearly forty millions in the eleven months. The manufacturing increase in May was from $34,798,331 to $38,984,561. We are glad to note these evidences of steady export trade, now so vital a part of our trade and commerce; and we are glad also to observe signs of great activity as to foreign electrical projects involving the use of American electrical material and apparatus. This appears to be particularly true of Mexico, where hydro-electric development is still proceeding at a rapid rate; but there are other parts of the world where the recent granting and execution of vast franchises will involve similar conditions favorable to the American electrical manufacturer, if alert, progressive and enterprising.

THE A. I. E. E. CHICAGO MEETING.

Elsewhere will be found a very complete report of the high-tension transmission discussion at the Chicago meeting last week of the American Institute of Electrical Engineers. It will be recalled that abstracts of the papers forming the subject of the discussion appeared in our issue of June 11. We shall return again to the subject of this interesting meeting, at present merely pointing out how by intelligent and well-directed effort, such as that put forth by Mr. Ralph D. Mershon and his fellow members of the Transmission Committee, interest in the work of the Institute may be greatly increased and the value of its *Transactions* much enhanced. Indeed, the work of this committee in fostering within the Institute the interests of the branch with which it is identified seems clearly to indicate the desirability of a reorganization of the Institute Committee on Papers by the addition to it of sub-committees representing all of the more important branches of electrical engineering, and charged with the duty of securing papers and arranging for discussions in their respective branches, according to a general programme as to subjects and dates to be drawn up annually. The only systematic effort heretofore along these lines has been with relation to the single subject of high-tension transmission, and has resulted in a record of several of the most successful meetings in the history of the Institute. The possibilities of a general plan along the same lines being thus made obvious, it surely seems that some action is called for whereby a balanced programme may annually be drawn up and carried out, assuring to other branches their proper prominence in the *Transactions*, which otherwise may be lacking. Still another lesson taught by the recent Chicago meeting is the advantage of holding at least an occasional monthly meeting of the Institute outside of New York. We hope within the next several years to report such meetings held at Pittsburg, Schenectady, Boston, San Francisco, Niagara and other prominent electrical engineering centers.

ELECTRICAL EXHIBITS AT ST. LOUIS.

The exhibits in the Electricity Building at the Louisiana Purchae Exposition have reached a state of completeness which renders it possible to estimate the value of the collection as a whole to the

electrical industry, and judgment formed cannot fail to reflect credit on the management of the Department of Electricity. We are not in sympathy with overcritical electrical men who complain that among the exhibits at St. Louis there is nothing radically new to electrical engineers. Radically novel things in the electrical line do not conveniently materialize to appear for the first time at a great exposition. But new things in the electrical line there are, and plenty of them. In the field of electric lighting alone the display of new sition. In the field of electric lighting alone the display of new illuminants is not by any means insignificant. Most notable among these is the mercury vapor arc lamp in two forms, both of which have been brought to a commercial stage since the Pan-American Exposition, to say nothing of the mercury vapor arc lamp's brother, the rectifier, which is also shown in two commercial forms. The mercury vapor lamps, taken together with the improved Nernst lamps, which are now taking an important place in commercial lighting, and the luminous magnetite arc lamp, form a collection of new things which should satisfy any one who knows what the bringing to commercial perfection of any new illuminant means in the way of discovery, investigation and experiment.

It must not be forgotten, however, that an electrical display such as that at St. Louis is not by any means for the sole benefit of electrical men. In fact, quite the contrary is the case. One of the great objects of such an exhibition is to educate the public and semi-technical men as to the uses of electricity. In this connection we cannot refrain from mentioning the splendid collection of motor-driven machine tools and various other appliances which have been brought together at St. Louis. It would have been a matter of much regret had Prof. Goldsborough, as chief of this department, relinquished his strenuous efforts to have electric motors shown actually applied in the work they do in practical, every-day operation. An electric motor in the abstract may be of no interest to the layman, and perhaps the greatest value to the electrical industry lies in showing the numberless convenient applications that can be made of the electric motor; for the exhibition of motors actually connected to and driving various classes of machinery has an interest to the layman that no amount of "warehouse" exhibits can have. It was announced in the early days of the Louisiana Purchase Exposition that the idea of working exhibits would be predominant. With the exception of Machinery Building, which is the power plant of the Exposition, no large building of the Exposition has in it as large a percentage of moving machinery as the Palace of Electricity, and the electrical exhibits can, therefore, be said more nearly to carry out the original predominant idea than any others, with the exception noted.

It must be a matter of regret to the numerous exhibitors in the electrical department whose exhibits pertain largely to illuminating appliances, that the Exposition authorities have as yet failed to authorize the opening of the Palace of Electricity at night. It would seem that whatever might be the objections to opening other large buildings, the Palace of Electricity above all should be essentially a night exhibit, since so large a percentage of the exhibits in it are devoted to artificial lighting, and artificial lighting can only be shown to advantage at night. It is the building to which the public naturally turns at night, but which so far has been closed to it.

THE ELECTRON THEORY OF MATTER AND ITS MOTION.

In the June number of the *Philosophical Magazine* Prof. J. Larmor discusses the bearing of the electron theory of electricity and matter on the observed behavior of matter moving relatively to ether. If matter is different from the ether and displaces the ether as a balloon displaces air, then a wave of ether should precede a moving mass just as an air wave precedes and accompanies a moving rifle bullet, or a water wave precedes and accompanies a steam launch advancing along a canal. The movement of the earth in its orbit around the sun at a speed of about 100,000 kilometers per hour might be expected to produce an appreciable ether wave that might give rise to secondary optical effects, such as in the apparent positions of the stars at different angles to the line of advance. Nothing of the sort has, however, yet been detected. Similarly, if matter displaces the ether, the rapid spinning movement of a massive fly-wheel or metal disc might disturb the path of a ray of light passing through the ether close to the edge of the disc. But no such disturbance can be found. On the electron hypothesis, however, that matter is composed of electric atoms, and that an electric atom is a local disturbance of the ether, just as a vortex ring of smoke is a visible local disturbance of air, this independence of matter movement and of neighboring ether would be a necessity and not a paradox.

AN EDUCATIONAL TEMPEST IN A TEAPOT.

Educational circles in New England seem to have been terribly stirred up recently over a project to arrange some sort of alliance between Harvard University and the Massachusetts Institute of Technology. For both institutions it is quite needless to say that we have the highest respect. Until recently they have represented somewhat different ideals of education, and they will doubtless preserve such differences for a long time to come. Both give scientific and engineering instruction of which they have the right to be proud, but Harvard has in general developed in the direction of pure science, the Institute of Technology in the direction of applied science. Now through the magnificent McKay bequest Harvard has had thrust upon her the plain duty of fostering engineering, which heretofore, although admirably administered, has occupied only a secondary place in the University as the public sees it. From the terms of the bequest it is pretty clear that if developed independently, the McKay foundation would of necessity duplicate much of the line of work of the Institute of Technology and come more or less directly into competition with it. It is but natural, therefore, that the heads of the respective institutions should consider the matter both severally and jointly. We can hardly conceive of a great and broad-minded educator like President Eliot plotting the discomfiture of a neighboring institution, and certainly Harvard University needs no such subterfuge. On the other hand, President Pritchett, fully realizing the possible difficulties of the situation, should be as jealous of the prestige of the Institute of Technology as if he were the oldest alumnus, and must be assumed to be working in good faith for her future.

Such being the case, it seems to us that the present excitement over the matter is altogether premature. The Technology alumni have made their opinion heard in no uncertain tones, and this of itself should be enough to insure peace with honor. They have made it perfectly plain that they will not endorse any steps that will sacrifice in the least the independence of their Alma Mater, and this of itself should settle that point at the outset, if indeed there has ever been any doubt about it. An Alumni Association, while without formal legal rights, is a hornet's nest that no wise man will wittingly stir up. The important practical question is the establishment of cordial co-operation between two great institutions of learning, and in this the public has a direct and vital interest. This we believe to be the problem which the governing bodies of Harvard and Technology have under earnest advisement, and in the interest of higher education it ought to be solved. Personally, we do not believe that any sort of organic union is necessary to this end, and we

doubt whether such union would be even desirable. An institution colossal in numbers is not in itself an end to be sought—it resembles a colossal telephone exchange in which the complication of free intercourse increases far more rapidly than the absolute number of subscribers. The economics of the situation are not generally improved by large consolidations for the very simple reason that the instructing staff of a university in these days is already worked at high pressure and must increase at least as fast as the number of students if efficiency is not to be sacrificed.

It does seem to us, however, that a concordat might be established which would be of great service to both institutions and to the cause of education. Harvard University has already set a noble example in assisting the advance of learning. Its available funds have more than once been placed at the disposal of sister institutions for the common good in the promotion of research. At this juncture, when a great foundation will soon become available for the improvement of technical education, there is no reason to expect that this beneficent policy will be suddenly reversed. Two large and well-equipped institutions ought to be able to arrange an exchange of courtesies and facilities, if nothing more, such as would add materially to their mutual effectiveness. It is not necessary to establish an educational trust in order to reap the advantages of co-operation. Each institution has certain facilities and advantages that the other lacks, and which might be exchanged to their mutual gain by a purely friendly arrangement. Moreover, the McKay bequest on its face implies certain facilities which neither institution at present possesses, and which, therefore, should not constitute a direct source of competition. It is most unfortunate that the discussion of the situation should have taken an acrimonious turn in any way, and we hope that both institutions will get down to a basis of calm and dignified endeavor to establish a mutual understanding. Technical education is no place for the display of commercial rivalry or personal animus, and such considerations are utterly beneath the dignity of the great institutions concerned. We trust that they will find a common ground upon which they can meet for common effort with honor to both.

IRON LOSSES IN LOADED TRANSFORMERS.

Every age has its pet subject of dissension, a bone of contention over which every aspirant can wrangle. The stimulus thus afforded is beneficient and inspiring, when the contention is confined strictly to argument. In the middle ages a great dissension is stated to have occurred among certain universities of Europe as to how many angles could simultaneously dance upon the point of one needle. The decision to this time-honored and pointed vexed question has not yet been pronounced, so far as we are aware. Electricity, likewise, has had its share of dissensions. The one-fluid and two-fluid theories of electricity, the contact theory and the theory of the action of the ground-return circuit, have all been rife sources of discussion in the past. This discussion has always stimulated experimental research and has thus been a factor for scientific and technological advance. In electrical engineering there has fortunately always been a fashionable topic for contention. One of the grandest of these has been the relative superiority of direct and alternating-current systems of distribution. Without this time-honored wrangle to fall back upon, many an electrical gathering that dissolved merrily after debate would have gloomily scattered in silence and sorrow. Yet the stimulus of the discussion has markedly aided invention and sharpened ingenuity.

Only about twelve years ago much dissension existed on the nature and distribution of power losses in transformers. Some averred that transformers were subject to relatively large losses of power all day. Others said that these losses only occurred at night, when the load came on. Yet others stated their belief that the losses were quite insignificant. Experience and experiment have shown that the truth lies between these contesting positions, although nearest to the last-named. It is now admitted that the losses in a constant-potential transformer are of two kinds, namely, the iron losses, due to hysteresis and eddies, and the copper losses, due to I^2R in both windings. For practical purposes, the iron losses in operation may be regarded as constant all the year round, while the copper losses increase with the load. These conclusions were attained by a number of observers independently about the same time. When, however, the facts are required to more than a practical first approximation, such as suffices the station manager or operating engineer, then secondary considerations must be taken into account. Thus, it is found that the iron losses in the ordinary constant-potential transformer slightly diminish as the load is applied, the copper losses increasing according to the I^2R law. This is accounted for by the $I\,R$ drop of pressure in the primary coil. If this drop of primary pressure amounts to, say, 1 per cent. at full load, then the c.e.m.f. and induction density in the core fall off likewise by 1 per cent. If the iron loss were all hysteretic, this would reduce the iron loss 1.6 per cent., approximately. If the iron loss were all in eddy currents, it would reduce the iron loss 2 per cent. Since two-thirds hysteretic and one-third in eddies is a common ratio, the 1 per cent. drop in induction at full load will mean about 1¾ per cent. reduction in iron loss.

Thus far, however, the influence of magnetic leakage has been ignored, so that the above estimate applies only to transformers without sensible magnetic leakage. When the leakage is small the effect will be somewhat to reduce the iron loss under load. When, however, the leakage is very marked, its effect will completely demolish the above estimate. The article by Dr. E. S. Johnnott, which appears on page 8 of this number, deals in an interesting manner with the variation of iron loss in magnetically leaky, and in unleaky, transformers. The method of testing adopted is shown in the article to have been purposely varied from the practical condition of constant primary e.m.f. at terminals, and was referred instead to constant induction density, leaving the primary terminal impressed e.m.f. to vary at its own will, subject to that condition. It is shown that when the transformer was so connected as to have but little magnetic leakage, the iron loss remained sensibly constant at the constant density in the core of 5,050 gausses. When, however, the windings were so distributed as to present large magnetic leakage, the maintenance of the same gaussage in the primary coil was accompanied by a marked reduction in iron loss as the secondary circuit was reduced in resistance. The reason for this seems clear. The effect of c.m.m.f. of the secondary coil would be to throw the flux of the primary coil out of the core into the surrounding air, whereby the length of the core would be virtually diminished, or the density in a large part of the core reduced. Consequently, the hysteresis and eddy currents paid for by the primary excitation would be lessened. With the same magnetically leaky transformer, when the gaussage was kept constant in the secondary winding, the iron losses increased with load. This would be owing to the greater density in the primary needed to pay for the constant secondary gaussage, as well as for the increasing primary leakage. The primary core would, therefore, be more nearly saturated at full load, with marked increase in iron losses. Now that Dr. Johnnott has corroborated the general theory of the subject by this research, it would be both interesting and important if some one would investigate the actual extent of reduction in the iron losses of practical transformers of different sizes and manufacture, when the impressed primary terminal e.m.f. is constant and the load is steadily increased.

International Electrical Congress of St. Louis.

It is announced that a number of national electrical bodies have arranged to co-operate in the International Electrical Congress of St. Louis. A number of these co-operating bodies are to hold simultaneous conventions in St. Louis during the Congress week, and to hold joint sessions with specified sections of the Congress on definitely appointed days. Other bodies are not going so far as to hold simultaneous conventions and joint sessions, but have accepted invitation to send delegates to the Congress. Invitations to send delegates have been sent to thirty national electrical and scientific bodies all over the world.

The following bodies have already promised to hold simultaneous conventions and joint sessions: The American Institute of Electrical Engineers, the American Electrochemical Society, the American Physical Society, the International Association of Municipal Electricians, the American Electrotherapeutic Association. The following bodies have promised to send delegates to the Congress: The National Electric Light Association, the Association of Edison Illuminating Companies. In Europe the following bodies have promised to send delegates to the Congress: The Société Internationale des Électriciens, the Sweizerischer Elektrotechnischer Verein.

It is expected that the Institution of Electrical Engineers of Great Britain and the Electrotechnischer Verein of Berlin will also send delegates. It is hoped that other European national electrical bodies will also co-operate. The delegates accredited to the Congress from various co-operating bodies are not expected to be called upon to vote upon any questions of national importance. All matters concerning units, standards, etc., will lie within the province of the Chamber of Government Delegates.

All delegates of the co-operating bodies are invited to read papers before any section of the Congress they may select. Such papers will be printed in the Congress *Transactions* as being offered by the delegate on behalf of the co-operating body. The paper and discussion thereon will subsequently be offered by the Congress to the co-operating body for incorporation in its own *Transactions,* if desired.

The delegates of the American Institute of Electrical Engineers and their papers to the Congress are as follows: Mr. Ralph D. Mershon, Section D, "The Maximum Distance to which Power Can Be Economically Transmitted"; Prof. M. I. Pupin, Section A, "Electrical Impulses and Multiple Oscillators"; Prof. C. P. Steinmetz, Section D, "The Theory of the Single-Phase Motor."

The delegates of the Electrochemical Society and their papers to the Congress are as follows: Prof. W. D. Bancroft, Section C, "The Chemistry of Electroplating"; Prof. H. S. Carhart (with Dr. G. A. Hulett), Section C, "The Preparation of Materials for Standard Cells and their Construction"; Prof. L. Kahlenberg, Section C, "The Electrochemical Series of the Metals."

The delegates of the National Electric Light Association and their papers to the Congress are as follows: Mr. George Eastman, Section E, "Protection and Control of Large High-Tension Distributing Systems"; Mr. G. Ross Green, Section E, "American Meter Practice"; Dr. F. A. C. Perrine, Section D, "American Practice in High-Tension Line Construction and Operation."

The delegates of the Association of Edison Illuminating Companies and their papers to the Congress are as follows: Mr. W. C. L. Eglin, Section E, "Rotary Converters and Motor-Generators in Connection with the Transformation of High-Tension Alternating Current to Low-Tension Direct Current"; Mr. L. A. Ferguson, Section E, "Underground Electrical Construction"; Mr. Gerhard Goettling, Section E, "Storage Batteries as an Adjunct to Station Equipment."

The delegates and papers of the other co-operating bodies have not yet been appointed.

In response to invitation, the following foreign governments have appointed delegates: Switzerland, Prof. Ferdinand Weber, Prof. François Louis Schule; Norway and Sweden, Prof. G. Arrhenius; India, Mr. J. C. Shields; Mexico, Mr. Rafael R. Arizpe.

The appointments from Great Britain, France, Germany, Austria-Hungary, United States, Belgium, Italy, Denmark, Spain, Portugal, Australia, Japan, China, Brazil, Chili and Peru have not yet been made. It is stated that appointments are being made.

The following are the programmes of papers promised for Sections F and G. Similar programmes of Sections A, B, C, D and E have already been published.

SECTION F—ELECTRIC TRANSPORTATION.

Chairman, Dr. Louis Duncan; secretary, Mr. A. H. Armstrong.

Author.	*Title of Paper.*
Ernst Danielson,	Theory of Compensated Repulsion Motor.
Philip Dawson, Esq.,	Electrification of British Railways.
Herr F. J. Eichberg,	Single-Phase Electric Railways.
Prof. Dr. F. Niethammer,	Alternating vs. Direct-Current Traction.
Prof. Dr. Rasch,	The Puffer Machine in Railway Service and Its Most Suitable Control.
A. H. Armstrong,	The Electrification of Steam Lines.
B. J. Arnold,	Electric Railways.
Louis Duncan,	General Review of Railway Work.
J. B. Entz,	The Storage Battery in Electric Railway Service.
C. O. Mailloux,	(To be announced.)
E. H. McHenry,	Some Qualifications of Electric Railway Equipment for Trunk Lines.
R. A. Parke,	Braking High-Speed Trains.
W. B. Potter,	Electric Railways.
F. J. Sprague,	The History and Development of the Electric Railway.
L. B. Stillwell,	Notes on the Electrical Equipment of the Wilkesbarre & Hazleton Railway Company.
H. G. Stott,	Central Station Economics and Operation.
W. J. Wilgus,	Equipping the Central Terminal.

SECTION G—ELECTRIC COMMUNICATION.

Chairman, Mr. F. W. Jones; secretary, Mr. B. Gherardi.

Author.	*Title of Paper.*
Señor Don Julio Cevera Baviera,	Electric Communications in Spain.
Dr. J. A. Fleming, F.R.S.,	The Present State of Wireless Telegraphy.
John Hesketh,	A New Danger to Lead-Covered Aerial Telephone Cables.
Herr Joseph Hollos,	Simultaneous Telegraphy and Telephony.
Saitaro Oi,	Telephony and Telegraphy in Japan.
V. Poulsen,	System for Producing Continuous Electrical Oscillations.
G. De la Touanne,	Questions Connected with Rates and Management in a Telephone Exchange.
J. C. Barclay,	Printing Telegraph Systems.
Dr. Albert C. Crehore,	Rapid Telegraphy.
Dr. Lee De Forest,	Wireless Telegraph Receivers.
Patrick P. Delany,	Rapid Telegraphy.
Hammond V. Hayes,	Telephony.
Franz J. Dommerque,	The Telephone Problem in Large Cities.
Reginald A. Fessenden,	Wireless Telegraphy.
J. C. Kelsey,	Features of Two-Strand Common Battery Systems.
Kempster B. Miller,	Problems. Automatic vs. Manual Telephone Exchange.
F. A. Pickernell,	Telephony.
Louis M. Potts,	Printing Telegraphy.
Col. Samuel Reber,	Military Use of the Telephone, Telegraph and Cable.
Prof. George F. Sever,	Electrolysis of Underground Conductors.
L. W. Stanton,	Economical Features in Modern Telephone Engineering.
John Stone Stone,	The Theory of Wireless Telegraphy.

Up to June 23, 1,776 adhesions to the Congress had been received, and over 150 papers promised. Twelve of these papers have already been delivered. Arrangements are now being completed for printing papers in advance of the Congress, so that all that are received in sufficient time will be ready for circulation among the Congress members at St. Louis. Efforts are being made to secure as many of the promised papers as possible in advance.

It is expected that the opening session of the Congress and the sessions of the sections will be held in the Coliseum building, situated in the heart of the city and therefore in close proximity to the hotels at which members will be quartered. The final session of the Congress may be held within the Exposition confines on Saturday, September 17.

A Peruvian High-Voltage Transmission Plant.

BY A. L. KENYON.

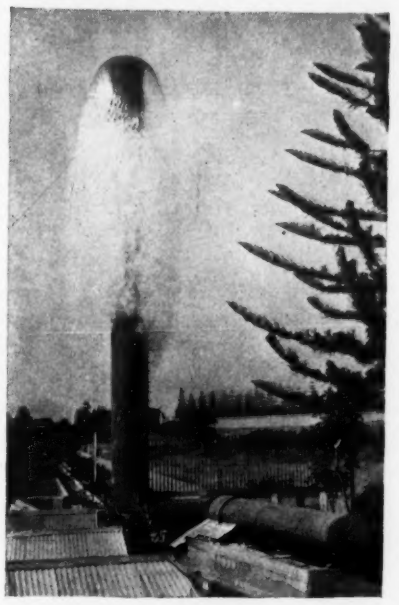


FIG. 1.—STAND PIPE, SANTA ROSA, LIMA, PERU.

THAT the highest voltage long-distance transmission line in South America is to be found in Peru, the land of the Inca sun worshipers, speaks well for the progress of that remarkable country. To the traveler who only sees the country from the steamer while passing down the coast, the view presents an almost barren sight, not a tree or shrub, only desolate mountains meet the eyes—one of the last places to expect to find a modern hydro-electric installation. The port is Callao; Lima, the capital, is eight miles inland. This and the neighboring towns are lighted from Chosica, 25 miles up the valley, at the foot of the Andes.

The River Rimac is one of those mountain streams that are torrents part of the year and then grow so small before reaching the sea as only to be found on the map. At Chosica the river has a fall of about 4 per cent. and rushes through a space some 50 ft. wide. At the minimum stage it has a discharge rate of about 20,000 cu. ft. At a point 6,000 ft. above the power house a concrete dam has been built, diverting the water to a canal excavated alongside the mountain. This canal is 9 ft. high and 24 ft. wide at the top, with a slope of one in two. A velocity of 4 ft. per second serves to keep the canal clear of sand, and as the banks are mostly of clay and rocks, this high velocity has no ill effect. Like all mountain streams, this river carries great quantities of sand and gravel, hence the necessity of the high velocity.

The bed of the river is formed of "Cascajo," or gravel, to a great depth, and the most difficult task was to secure a firm foundation for the concrete dam and gates. This has been accomplished by the use of a coffer dam and centrifugal pumps. An abundance of decomposed granite, sand and broken rock was found close at hand. A concrete composed of two parts hydraulic cement, three of sand and three of broken rock, mixed dry, was used in the work. Some 800 ft. beyond a settling basin of considerable depth was formed in the canal, with a waste gate to discharge the sand and gravel at times of high water. From the forebay, built of stone and cement, two 5-ft. steel pipe lines ¼ in. thick and 2,000 ft. long lead to the station on the edge of the river. Here an effective head of 155 ft. is secured. The building is of solid stone, 40 by 200 ft., with a separate fire-proof bay 16 by 50 for all high-tension wires, lightning arresters, transformers and oil switches.

FIG. 3.—CHOSICA STATION IN COURSE OF CONSTRUCTION.

FIG. 2.—CHOSICA STATION, SHOWING THREE UNITS.

At present the plant consists of three 2,300-volt General Electric

generators, direct-connected to Pelton double-nozzle, 80-in. wheels, giving 1,000 hp each. A fourth unit of double this size is being installed, thus giving 4,500 hp of capacity. Excitation is provided for by two separate Peltons, direct-connected to slow-speed exciters.

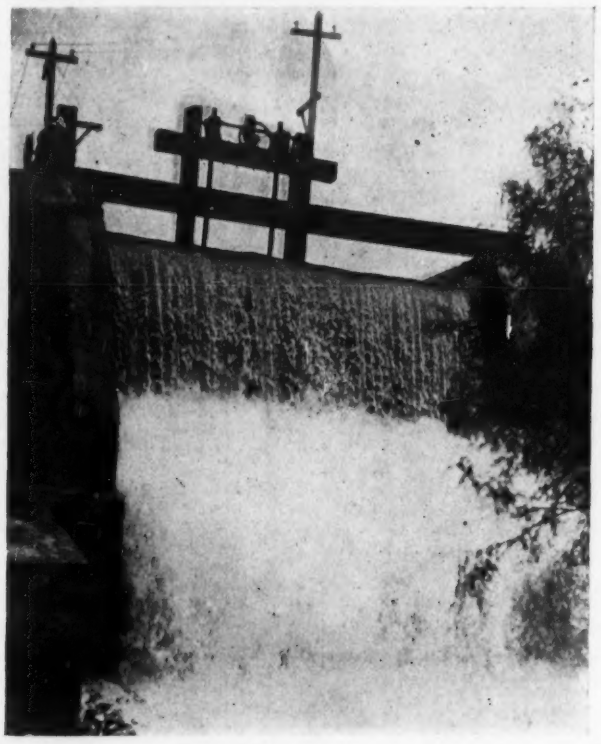


FIG. 4.—OVERFLOW AT END OF FOREBAY, CHOSICA.

From the two sets of low-tension bus-bars the current goes to two banks of oil and water-cooled transformers, where it is raised to 33,500 volts. The station is built to add two more 800-kw units in the future.

The pole line consists of 30 and 35-ft. white cedar poles, set 100 ft. apart, carrying 8 and 10-ft. arms. The transmission line consists of two circuits of No. 4 bare copper, forming an equilateral triangle having 36 in. on each side. Locke porcelain insulators tested to 90,000 volts and supported on iron pins are used. Within the first three months of operation the original insulators of another make had to be discarded owing to lack of ability to withstand the 33,500 volts. In the interim the plant was operated at 20,000 volts by changing from delta to star connection. The first section of the pole line passes over some very rugged mountains. Where there are changes in direction the poles are double-armed, and bolts are used

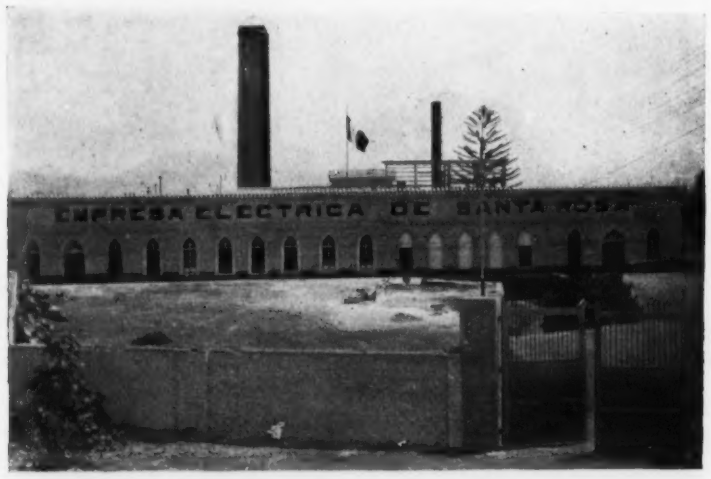


FIG. 5.—MAIN STATION, LIMA, PERU.

throughout for fastening arms to poles. A telephone line runs 5 ft. below and is transposed each ten poles; this gives a quiet line. Telephone connections are provided for the line inspectors at intervals.

At the Lima station the wires enter a fire-proof lightning arrester and switch house, after which they go to the main station to 40,000-volt oil switches and transformers. The voltage is then stepped down to 2,300 volts, at which it is handled in conjunction with the old steam and water power plant.

As the water supply is limited during a part of the year, the service is supplemented by a steam plant of 2,000 hp, consisting of McIntosh & Seymour vertical compound-condensing, 800-hp, direct-connected engines, and three vertical Westinghouse engines. The boiler plant consists of 2,000-hp capacity in Babcock & Wilcox boilers, with superheaters and Green economizers. Crude oil from the Peruvian oil fields is used under all boilers. This steam plant

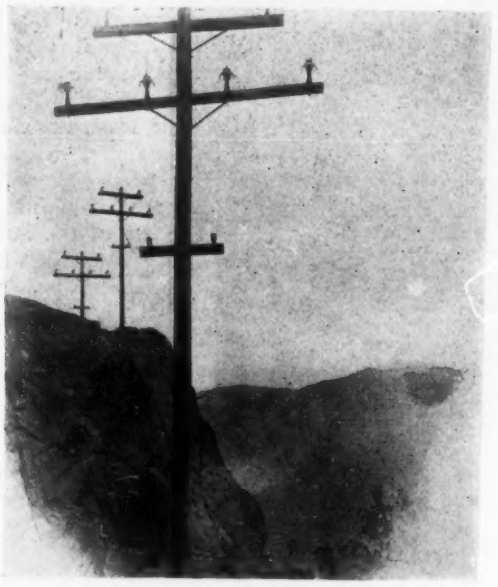


FIG. 6.—POLE LINE.

since the completion of the Chosica hydraulic plant is now only kept as a reserve. The hydraulic section at Lima consists of two 27-in. McCormick horizontal turbines, each direct-connected to 2,300-volt General Electric generators. The water for these wheels is brought from a reservoir having a capacity of 2,000,000 cu. ft. of water, through 2,000 ft. of 5-in. steel pipe. A standpipe of the same area is located near the wheels. The total effective head is 85 ft. Lombard water wheel governors are used, and the exciters are belted from the shafts of the turbines.

The current from all generators goes to one set of bus-bars having disconnecting switches. From here it goes to either or both sets of transformers. From the high-tension side of these the current goes through two sets of 40,000-volt oil switches (operated from panels) to two sets of high-tension bus-bars, where it can be thrown on to either one of the transmission lines or both. The same ar-

FIG. 7.—PIPE LINE.

rangement is followed at the Santa Rosa or Lima end for the incoming current. Transformers are connected delta.

The current is distributed from here for light and power, and to the sub-stations of the two suburban electric railways, one being at Miraflores, six miles away, and one at La Legua, midway be-

tween Lima and Callao. Voltage is stepped up to 10,000 volts for this purpose and reduced again at the sub-stations to 430 and used to operate two six-phase, 300-kw rotaries in each sub-station. Both roads have just been put in operation.

Besides the public and private lighting of the city of Lima a day

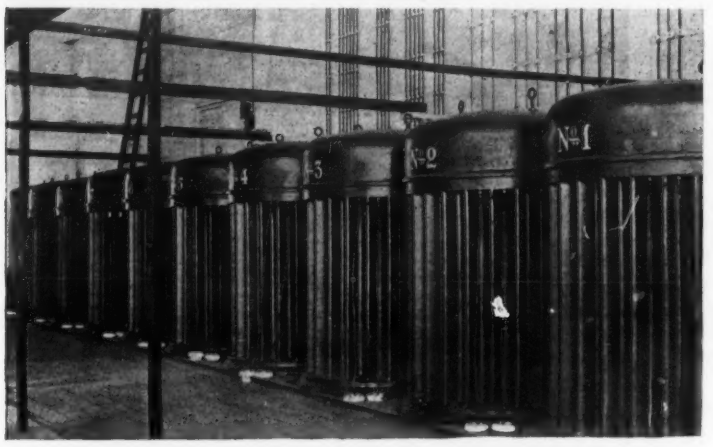


FIG. 8.—CONSTANT-CURRENT TRANSFORMERS.

load of some 1,000 hp is furnished to cotton factories and other industrial enterprises. The public lighting of the city of Lima is by the alternating enclosed arc light system of the General Electric Company. The Empresa (Co.) Eléctrica de Santa Rosa is composed entirely of Peruvians. The officers are: Don Gio Batta Isola, president; Doctor Mariano I. Prado y Ugarteche, manager, and A. L. Kenyon, electric and hydraulic engineer.

Invention and Success.

BY EDWARD VAN WINKLE.

THE peculiar trend of mind that is necessary for the conception of an invention is seldom coupled with the mechanical ability for the perfection of the minute details or the business genius necessary to make it commercially successful. The originality and power of conception possessed by the inventor bring into existence mechanical marvels, but the systematic precision of the engineer and the calculating methods of the promoter or capitalist are, after all, the qualities necessary to attract the attention of the world.

The stages in the formation of a commercially successful machine are many and they may be divided into three heads, each fully as important as the other two.

The first division belongs to the inventive genius who carries the suggestion through conception to invention. A suggestion is given him by some friend, through force of circumstances or necessity, or perhaps the thought suggests itself. The hypothesis is then carefully formulated and is at first assumed for the purpose of argument which suggests the conception upon which he theorizes until he solves the problem resulting in the invention. Therefore, we have the inventor as the head of the following stages or departments: (1) Suggestion. (2) Hypotheses. (3) Conception. (4) Theory. (5) Invention.

The second division is dependent upon the careful attention to details and precision of the engineer who brings the machine up to a standard of perfection.

The evolution of mechanic arts is due chiefly to the slow improvements, step by step, brought about not by the inventor, but by the engineer. It is safe to say that ninety-nine per cent. of all inventions passing through the world's patent offices are on some little improvement of an already existing art, machine, manufacture or composition of matter having as patentee an engineer who has given careful study to an existing invention having for its patentee one unskilled in the art. Thus, the composition as acquired of the inventor is combined with the personal equation of the engineer for expression of its appropriate characters, resulting in exhibition of the model. After long operation it is made perfect by practice. Thus we have the engineer responsible for (1) Composition. (2) Expression. (3) Exhibition. (4) Operation. (5) Perfection.

The third and last division is dependent upon the calculating methods of the business man. Exploitation along proper lines is certain of success. Too little importance is placed upon this division by inventors who are desirous of having their patents turned into a money-making business. On the other hand, records show that 95 per cent. of all industrial businesses fail some time in their existence and therefore a man must have considerable conceit to place himself in the successful five per cent.

To be among the successful five per cent. one must give careful attention to details through systematic management with a far-reaching insight in the future, and by this alone it is made possible to save that small percentage between success and failure.

Recapitulating and tabulating we have:

Commercially successful machine.	Inventor.	1. Suggestion. 2. Hypothesis. 3. Conception. 4. Theory. 5. Invention.
	Engineer.	6. Composition. 7. Expression. 8. Exhibition. 9. Operation. 10. Perfection.
	Capitalist.	11. Exploitation. 12. Success.

Honors are divided because the actual cash value of a patent is not in the patent itself, nor the perfect machine, but in the sale or use of the monopoly the patent affords and the perfect machine makes possible.

Hydro-Electric Development in Mexico.

In some interesting remarks on the development of water power in Mexico, United States Vice-Consul-General Conley, Mexico City, says:

It is commonly asserted that the principal obstacle to manufacturing in Mexico is the lack of native fuel, but this is actually not so great an obstacle as it appears. The people are just beginning to wake up to the vast unused water power of this country, which, fortunately enough, exists in great abundance near the larger centers of population. There are but very few large streams in this Republic, but owing to the mountainous nature of the greater part of its area there is an abundance of small streams, which, owing to their rapid fall, offer a great amount of power to be utilized. Certain obstacles, however, have to be overcome in using this water power. One especial fault is that many of the streams have dry beds for about six months of the year. The problem to be solved in such cases is how to profitably utilize the power which can be derived from such streams during the rainy season, when they are full. In some cases where power from streams that are dry during part of the year is now being utilized to generate electric power for lighting, etc., coal or other fuel is used during the dry season. The exclusive use of coal or other fuel for generating steam to run the plants would render the cost of their operation prohibitive to profits, but by using the water power for some six months of the year profits can be made.

Another great obstacle, similar to the one which is encountered in some of our own Southern States, is that of vegetable growths, such as water hyacinths, which at the present time greatly impede the use of water from streams infested with it. This obstacle has, however, been overcome to a very great extent in the United States, and there is no reason why it cannot be overcome in Mexico.

Of the great abundance of water power with which this Republic is supplied, it is estimated that not more than 250,000 hp is being utilized or is in the course of development at the present time. The potential horse-power has never been estimated with any degree of accuracy. According to an article which appeared in the *Mexican Herald*, of this city, recently, the average cost of power derived from steam in this city is between $190 and $225 Mexican currency, or $100 United States currency, per horse-power per annum. The Mexican Light & Power Company, a Canadian company, which is installing an electric power plant at Necaxa, in the State of Puebla, proposes to sell electric power in Mexico City at $120 to $125 Mexican currency, or $55 United States currency, per horse-power per year. This company proposes to develop about 100,000 hp, of which 80,000 hp will be transmitted to this city.

Iron Losses In Loaded Transformers.

BY DR. E. S. JOHONNOTT.

QUITE a number of observers[1] have found that the loss of energy in the iron of transformers falls off rapidly as the load in the secondary is increased. The explanation of such an effect is not readily apparent if the induction in the iron is kept constant. Ewing,[2] in a skillfully-performed experiment, found absolutely no variation in these losses; and his work has been amply confirmed by Fleming and others.

The object of the present paper, in the first place, is to offer an explanation of the apparent diminution in the iron losses with increased load in the secondary. And, in the second place, to determine, incidentally, not only the magnitude of the exciting current, but its phase with reference to the induction.

THEORY OF THE METHOD.

Let Fig. 1 be the polar diagram of the transformer. This representation is the same as that given by Steinmetz, with the exception that in the secondary the component e.m.f's required to overcome resistance and reactance are plotted instead of these counter e.m.f's themselves.

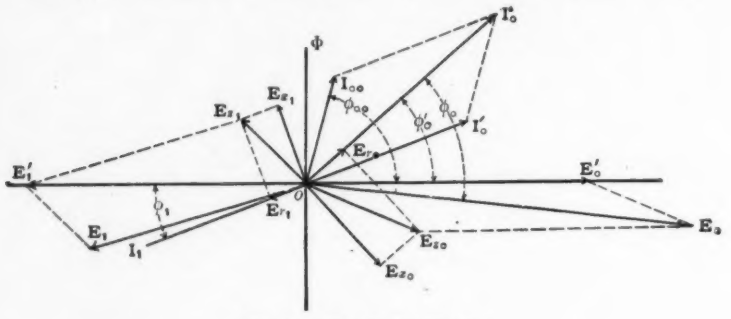


FIG. 1.—POLAR DIAGRAM.

Let $O\Phi$ be the vector representing the induction in the iron;

OI_0 the primary current;

OE_0 the e.m.f. impressed on the primary;

OE_0' the component of OE_0 required to overcome the e.m.f. induced in the primary by the induction common to the primary and secondary circuits;

and let OEx_0 be the component of OE_0 to overcome the leakage reactance of the primary;

and OEr_0 the component to overcome the resistance.

In the same manner,

let OE_1' be the e.m.f. induced in the secondary;

OEx_1 the e.m.f. to overcome leakage reactance,

and OEr_1 that to overcome ohmic resistance.

In all cases to be considered the primary and secondary had equal numbers of turns. Then, if OI_1 represents the secondary current, we may consider the primary current as made up of two components, one, OI_0', equal and opposite to OI_1, and the other, OI_{00}, the exciting current.

The activity involved in the various parts of the transformer may be expressed as follows:

$W_0 = E_0 I_0 \cos \phi_0$ = active watts impressed on the primary;

$W_0' = E_0' I_0 \cos \phi_0' = W_0$ less the I^2R losses in the primary;

$W_1 = E_1' I_1 \cos \phi_1$ = watts consumed in the secondary;

$W_{00} = E_0' I_{00} \cos \phi_{00}$ = watts consumed in the iron of the magnetic circuit,

where ϕ_0 = the angle $E_0 O I_0$;

ϕ_0' = the angle $E_0' O I_0$;

ϕ_1 = the angle $E_1' O I_1$;

ϕ_{00} = the angle $E_0' O I_{00}$;

$$a = \frac{\pi}{2} - \phi_{00} = \text{angle of hysteretic advance of phase.}$$

A measure of the loss of energy in the iron is also obtained by taking the difference between W_0' and W_1. Two methods are thus suggested for measuring these losses, viz.:

Method A.—To determine the difference between the power put into the primary, less its I^2R loss, and the total power expended in the secondary. This quantity is given by $W_0' - W_1$.

Method B.—To find directly the product of the induced e.m.f. common to the primary and secondary, the exciting current and the cosine of the corresponding angle of lag. This value is given by W_{00}.

Instruments and connections.—The measurements were taken with the Rayleigh Phasemeter.[3] With some modifications the instrument used was the same as that described in the *Physical Review*, Vol. XV, November, 1902, p. 276. The single needle of the suspended system, however, was replaced by one consisting of eight pieces of finer wire, mounted so as to lie one above another in the same vertical plane. The suspension fibre was phosphor-bronze strip.

The core of the transformer was built up of 198 rings of annealed steel. The external diameter of each was 49.5 cm.; the internal, 44.8 cm., and the thickness, .0343 cm.

FIG. 2.—DISTRIBUTION OF THE COILS.

This core was wound with 50 separate coils, each having 20 turns of No. 16 wire in two layers. The manner of distribution of the coils is shown in Fig. 2. The terminals of each coil were led to mercury cups in a board in the center and could be connected by heavy copper strips in series with any other coil in any order.

Three circuits made up of these coils were used, each consisting of 10 sections or 200 turns. One constituted the primary, another the secondary and the third a tertiary. As only induced e.m.f's were used in the measurements, it was thought to be more advisable to use a tertiary coil than to rely on measurements taken in the primary and secondary circuits.

The principal object in view in using this type of transformer was to study the effect of magnetic leakage. When it was desired to have as little leakage as possible between two circuits, the sections were intermingled as thoroughly as possible. To arrange for large leakage the coils were divided into groups *I, II, III, IV* and *V*, as shown in Fig. 2. Then three circuits were made up, each having 200 turns. One consisted of the ten sections in *I* connected in series;

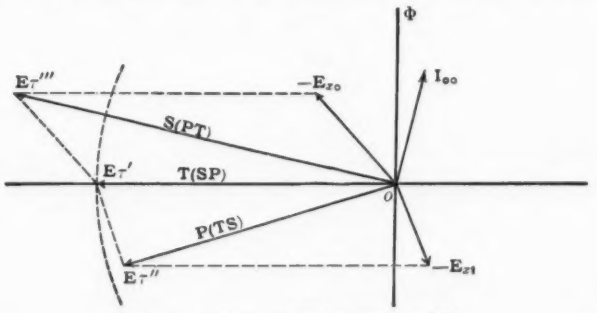


FIG. 3.—DIAGRAM FROM TEST DATA.

the other two circuits were made up in *III* and *IV*, with the sections of one intermingled with those of the other.

Suppose, now, that it was desired to have large leakage between the primary and secondary and to measure the induction in the secondary. The circuit in group *I* was made the primary; and one circuit in *III* and *IV* was made the secondary, while the other constituted the tertiary. Such an arrangement will be designated as *P (S T)*. If it was desired to measure the induction in the primary, the primary and secondary were interchanged. This will be designated *S (P T)*. Interchanging the secondary and tertiary will be designated *T (P S)*.

[1] Fleming, Alternate Current Transformer, Vol. II, p. 463.
[2] The Electrician, Vol. XXVIII, p. 111, 1891.
[3] A good description of the instrument and its principles may be found in an article by E. Place. ELECTRICAL WORLD AND ENGINEER, Vol. 33, May, 1899, p. 614.

The connections were quite similar to those described in the former paper.

Method A.—Two methods were employed in making the measurements. In order to determine $W_0' - W_1 = E_0'I_0 \cos \phi_0' - E_0'I_1 \cos \phi_1$, the primary coil was connected in series with the phasemeter current coil and the tertiary coil in series with the phasemeter e.m.f. coil. Then two readings were taken with the currents acting simultaneously on the needle.

The difference between the readings when these currents act in like and in unlike directions is proportional to W_0'. The watts applied to the primary outside of its I^2R loss is given, then, by

$$W_0' = E_0'I_0 \cos \phi_0' = \frac{h\,k}{4}(C_1^2 - C_2^2),$$

where C_1^2 and C_2^2 are the two readings and h and k are the constants of the current and e.m.f. coils, respectively.

Similarly, W_1 is given by substituting the secondary coil for the primary.

The loss of energy in the iron is then given by the difference between W_0' and W_1.

Method B.—In order to determine, W_{00}, the loss of energy in the iron, directly, a differential coil was added to the phasemeter. This was composed of five turns of No. 14 lamp cord and was placed close to the needle. Either section of this coil constituted a sensitive current coil of the phasemeter.

In a 1:1 transformer the exciting current, I_{00}, is the resultant of the primary current, I_0, and the secondary, I_1, and is represented by the vector, $O\,I_{00}$, Fig. 1. Evidently, all that is necessary in order to measure the exciting current, is to lead the primary current through one section of the differential coil and the secondary through the other section in the opposite direction. The result is the same as though a single coil similar to either section was made to carry the exciting current.

Putting the tertiary coil on the e.m.f. coil of the phasemeter and proceeding as in *Method A*,

$$W_{00} = E_0'I_{00} \cos \phi_{00} = \frac{h\,k}{4}(C_1^2 - C_2^2), \text{ etc.}$$

It was necessary to exercise considerable care in winding the differential coil, since for heavy currents in the primary and secondary their difference is a small percentage of either. To insure that the sections were similarly situated with reference to the needle, the ends of each coil were carefully twisted together. When the two sections were then connected in series in opposite directions and a current put on as heavy as the wire could bear, absolutely no deflection was produced.

The principal object aimed at in employing the two methods was to determine, if possible, any error that might be introduced due to wave form of the exciting current. If the loss of energy in the iron as given by *Method B* is consistent with that given by *A*, for the secondary loaded, then it is evident that the distortion of the exciting current is not sufficient to introduce any error. For in *Method A* the primary and secondary currents employed are quite approximately sine curves, while in *Method B* the determination depends directly on the distorted exciting current. If, therefore, the results given under these conditions are consistent, we are justified in assuming that the iron losses as measured for no load in the secondary are correctly given.

For no load in the secondary, that is, W_1 equal to zero, W_0' becomes equal to W_{00} and the two methods become identical.

One important advantage of both of these methods lies in the fact that an accurate determination of the resistance of neither the primary nor secondary is required.

In order to check out on the primary I^2R losses, readings of the total primary watts were taken in all cases. To effect this the phasemeter e.m.f. coil was shunted across the terminals of the primary.

Constants of the Phasemeter.—One current coil of the instrument consisted of three turns of heavy wire and was placed at a considerable distance from the needle. It was used to measure the currents when the transformer was heavily loaded. For measuring the lighter currents one of the sections of the differential coil was used.

The Kelvin balances were used in all of the calibrations.

The constant of the less sensitive coil was found to be $h_1 = 1.00$. Thus the current was given by $I = 1.00\ \sqrt{A^2}$, where A^2 was the reading produced by the current in it alone.

The constant of either section of the differential coil was $h_2 = .0975$. Thus the current was given by $I = .0975\ \sqrt{A^2}$.

The constant of the e.m.f. coil was found to be 4.21. Thus the e.m.f. was given by $E = 4.21\ \sqrt{B^2}$, where B^2 was the scale reading due to the e.m.f. coil.

The constants of the phasemeter, used as a wattmeter, as computed from the current and e.m.f. coil constants, were then:

$$l_1 = \frac{h_1 k}{4} = 1.0525 \quad \text{and} \quad l_2 = \frac{h_2 k}{4} = .1025.$$

Hence, when the less sensitive current coil was used the watts in any case were given by

$$W = l_1 (C_1^2 - C_2^2) = 1.0525 (C_1^2 - C_2^2),$$

and when the *a* section of the differential coil was used by

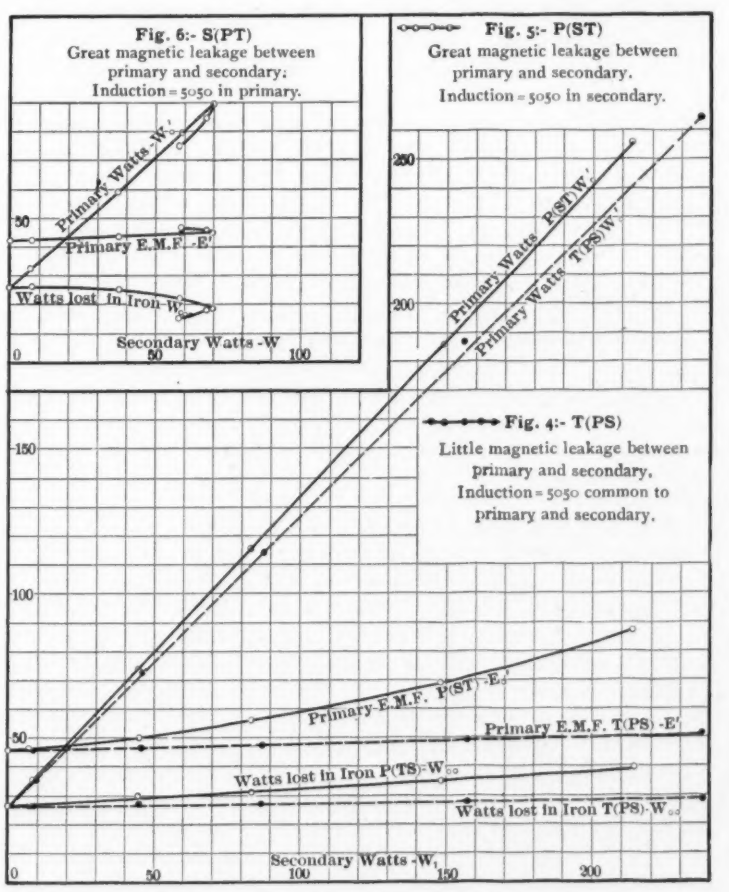
$$W = l_2 (C_1^2 - C_2^2) = .1025 (C_1^2 - C_2^2).$$

The city lighting mains were used in all of the observations. All readings were taken between 3.30 A.M. and 7.00 A.M., as it was found that both the e.m.f. and the speed were then most nearly constant.

The frequency was taken just before changing the load on the secondary each time. A description of the device used for this purpose will be found elsewhere.[4]

RESULTS.

The results are shown in the accompanying curves. The readings of each table from which the curves were constructed were taken in



FIGS. 4, 5 AND 6.—RESULTS OF TESTS.

a single morning. The curves correspond to transformers arranged for large magnetic leakage. A constant-induced e.m.f. of 42.1 volts was maintained in the tertiary corresponding to an induction of 5050.

DISCUSSION OF RESULTS.

In Fig. 4 the lines show graphically the quantities determined as functions of the secondary watts.

For no load in the secondary the iron losses were 27.6 watts, corresponding to a difference reading in the phasemeter of 269 divisions. As the secondary was loaded up to 56 lamps in parallel, a regular rise in the iron losses to 29.7 watts was given by the differential coil method. *Method A* shows a somewhat irregular rise. Coincident with an increase in the load in the secondary was also a

[4] ELECTRICAL WORLD AND ENGINEER, Vol. 43, Jan., 1904., p. 88.

rise in the magnitude of the exciting current, I_{00}, and an increase in the value of $cos\ \phi_{00}$. An increase in the primary e.m.f. from 44.8 to 53.9 volts was required to keep the induction constant in the tertiary.

In Fig. 5 the lines illustrate the characteristics of a loaded transformer in which the induction is maintained constant in the secondary. There was a considerably greater increase in the iron losses than is shown in Fig. 4. For a load up to 30 lamps only, the value of W_{00} rose from 27.2 to 39 watts, while by *Method A* the rise was from 27.2 to 42.5 watts. There was a correspondingly greater rise in the values of the exciting current and $cos\ \phi_{00}$. The primary e.m.f. required to keep the induction constant in the tertiary rose to 85.6 volts, or double that induced in the secondary. All of the curves in Figs. 4 and 5 were ruled with a straight-edge, with the exception of the e.m.f. in Fig. 5; thus the indications are that all of these quantities are exact linear functions of the secondary watts.

Perhaps the most remarkable effect of magnetic leakage is exhibited in Fig. 6, which illustrates the characteristics of a loaded transformer, with the induction maintained constant in the primary.

So far as could be learned, all of those observers who found a remarkable diminution in the loss of energy in the iron with increase of the load in the secondary, employed a constant e.m.f. in the primary. The effect is shown in the present data in a marked degree, and is doubtless due to the exaggeration of the effects of magnetic leakage. In fact, it was found to be impossible to have the transformer in the room on account of the effect of its stray field on the needle of the phasemeter. Some notion of the effect of leakage may be gained from the comparison of the lengths of the corresponding curves in the plates for the same number of lamps in the secondary.[5]

It was found in taking the readings of the curves of Fig. 6 that, as the resistance in the secondary was continuously lessened, the primary and secondary watts reached maximum values simultaneously and then decreased. But by *Method A*, as well as *B*, a continuous decline in the value of the iron losses was observed. Also a regular decline in the value of $cos\ \phi_{00}$ occurred, while the exciting current, I_{00}, at first showed a slight rise and then a continuous decline.

That there should have been a rise in the magnitude of the exciting current in the case of Fig. 5 and a fall in Fig. 6 would appear from the following considerations:

Let N_0 = the linkage of lines of force with the primary due to the current in it, assuming the secondary absent;
N_1 = linkage of the secondary, assuming the primary absent;
N = linkage with the tertiary, which is kept constant;
β = the coefficient of magnetic leakage.

Then $N_0 - (N_1 - \beta N_1) = N_0 - N_1 + \beta N_1 = N$ is the actual induction in the tertiary when in the field of the primary. Likewise, $-\{N_1 - (N_0 - \beta N_0)\} = N_0 - N_1 - \beta N_0 = N$ is the actual induction in the tertiary when that coil is in the field of the secondary. Therefore,

$$N_0 - N_1 = N - \beta N_1 \text{ for } S\ (P\,T) \text{ and}$$
$$N_0 - N_1 = N + \beta N_0 \text{ for } P\ (S\,T),$$

where $N_0 - N_1$ in either case is proportional to the exciting current. In other words, the exciting current should decrease with an increase in the current in the secondary, when the tertiary is in the field of the primary; and when the tertiary is in the field of the secondary, increase with the current in the primary. This is on the assumption that β, the coefficient of magnetic leakage, remains constant. This explanation accords with the results recorded in Figs. 5 and 6.

Possibly a clearer and more complete interpretation of the results may be obtained through the diagram in Fig. 1.

Suppose, in Fig. 3, that we let $-O\,Ex_0$ be the actual leakage e.m.f. in the primary and at the same time $-O\,Ex_1$ the like quantity in the secondary. If, now, $E\tau$ be the e.m.f in the tertiary when it measures the mutual induction in the primary and secondary circuits; then the e.m.f. induced in the primary is $O\,E\tau'''$ and in the secondary $O\,E\tau''$. In all of the experiments the magnitude of the e.m.f. induced in the tertiary was the same in the three positions; that is, $E\tau'$, $E\tau''$ and $E\tau'''$ were all constrained to lie on the arc through $E\tau'$. Thus, it is evident that the mean induction in the iron for Fig. 4, $T\ (S\,P)$, was greater than in Fig. 6, $S\ (P\,T)$, and less than in Table 5, $P\ (S\,T)$. This explanation accords with the manner in which the iron losses and the exciting current were shown to vary in the different tables of observed data.

In still one other respect is there conformity with the curves. That there should have been an increase in the value of $cos\ \phi_{00}$ in Fig. 5 and a diminution in Fig. 6 is readily apparent, since the leakages increase with the primary and secondary currents.

The differential coil method might be applied to measure, directly, the leakage between the primary and secondary. Suppose a tertiary to be wound in the field of the primary and another with an equal number of turns in the secondary. Now provide the phasemeter with a differential e.m.f. coil. Lead the current from one tertiary through a section of the differential coil and that of the other tertiary through the other section in the reverse direction. The scale reading would be proportional to the square of the relative leakage induction.

It does not appear from these observations that the loss of energy in the iron is constant in any case. It is, however, most nearly so for the $T\ (S\,P)$ data. The indications that the iron losses are independent of the secondary load are much more evident from observations taken with as little leakage among all of the circuits as it was possible to obtain.

The accompanying table contains results in which the sections of the primary, secondary and tertiary were as thoroughly intermingled as possible. In the first section of the table only the ten three-coil spools were used, Fig. 2. The inner sections, connected in series, constituted the tertiary, the middle the secondary, and the outer the primary. In the second section of the table is given the results for the circuits made up of the thirty sections lying directly on the core. Each circuit was made up by connecting every third section in series.

SMALL MAGNETIC LEAKAGE AMONG THE PRIMARY, SECONDARY AND TERTIARY CIRCUITS.

	Section I			Section II		
Load Lamps	I_{00} Amp.	$Cos\phi_{00}$	W_{00} Watts	I_{00} Amp.	$Cos\phi_{00}$	W_{00} Watts
0	.804	.804	27.1	.801	.812	27.4
1	.804	.815	27.6	.805	.820	27.7
5	.828	.804	27.9	.828	.805	28.0
10	.833	.800	28.0	.850	.797	28.5
20	.855	.801	28.9	.860	.793	28.7
33	.855	.801	28.9	.866	.792	28.8
56	.855	.801	28.9	.888	.780	29.1

The two sections of this table, in the values shown for I_{00} and W_{00}, bear a close resemblance to each other and to the values of Fig. 4. $Cos\ \phi_{00}$, however, remains nearly constant, particularly in section *I* of the table.

This table indicates that the phase of the exciting current, with reference to the induction, remains constant, and that it is largely an increase in the magnitude of the exciting current that contributes to an increase in the loss of energy in the iron.

Of course, it should be remembered that there is still considerable leakage between a section of any circuit on one side of the transformer core and another on the other side.

In all, twenty-six tables were taken, and all indicate that when the leakage is small among the circuits the iron losses are quite nearly constant, but have the characteristics of the curve plotted in Fig. 5, $P\ (S\,T)$.

The loss of energy in the iron includes both hysteresis and eddy-current losses. A rough computation gave the eddy-current loss about 7 per cent. of the total.

Several tables were taken with other transformers. Rings *B* and *C*, described in the previous paper, were wound similar to the transformer used above, and yielded similar results. The effects of magnetic leakage, however, were even more pronounced in these split magnetic circuits. The ring of fine iron wire gave the most nearly constant values for the exciting current that were obtained.

CONCLUSIONS.

The conclusions to be drawn from the foregoing results, together with others that were taken, may be stated briefly as follows:

I. In a transformer in which there is considerable magnetic leakage between the primary and secondary circuits, and in which a constant induction is maintained and measured,

(*a*) In the field of the primary. There is an apparent decrease in the loss of energy in the iron, in the magnitude of the exciting current, and in the cosine of the angle between it and the induced e.m.f. as the load in the secondary is increased.

(*b*) In the field of the secondary. There is an apparent increase in the loss of energy in the iron, the magnitude of the exciting current and the cosine of the angle between it and the induced e.m.f. as the load in the secondary is increased.

II. If the load is increased in the secondary of a transformer in which there is little leakage, not only the loss of energy in the iron, but the exciting current and its phase with reference to the induction, remain constant.

It is desired to thank Prof. Thomas Gray for a number of suggestions and his continued interest in the work.

[5] That the difference in the results among the tables is due to magnetic leakage, largely, is confirmed in almost every particular by the results of some calculations given by Prof. J. Perry, Phil. Mag., Vol. XXXII, 1891, p. 178.

Electric vs. Hydraulic Cranes for Riveter Towers.

BY FRANK B. KLEINHANS.

THERE is scarcely any machine as efficient as the average run of electric motors. When we think of this fact we are not surprised to note the change from mechanical, hydraulic and compressed air cranes to electric cranes. While these changes have been going on in our modern shops, in new riveting plants the crane for handling the boilers or structural steel work is apt to be operated by hydraulics. The reason is, perhaps, that the builders of the hydraulic machinery supplied the whole equipment, and as electric motors are out of their line, they naturally advocated the adoption of the hydraulic crane.

One point in connection with the capacity of these hoists is of interest. A company which is manufacturing a boiler requiring a crane of 15 tons capacity, will specify that the hoist shall have a capacity of 25 tons. With an electric crane this would not be a serious mistake, but with a hydralic crane, the increased capacity over and above that which is necessary represents just that much constant loss in efficiency.

There are a number of hydraulic cranes in operation which have a capacity of 25 tons and yet the average weight on these cranes is less than 8 tons. The crane is thus operating with three times as much power as will actually be required to do the work. In addition to this, the total pressure on the frame of the hydraulic hoist is made 25 per cent. greater than is theoretically required to lift the load, this being allowed to overcome the friction of the chain, shives, idlers, etc. It can readily be seen that, under these circumstances, the cost of operating the hydraulic crane is several times greater than that of an electric crane. We can take an electric crane, for instance, and raise the hook from the ground to its highest position in the riveting tower with the expenditure of little energy. With the hydraulic crane, however, just as much power is required to raise the empty hook as would be required to lift so heavy a load that the crane would barely be able to move it.

Any one who has moved the trolley of a hydraulic crane under a heavy load, will tell you that it is no easy work. In order to make it easier for the operator to move the trolley under a load, a high gear ratio is provided. This means that although the trolley moves easier, it also moves much slower. Therefore, what one gains in ease, he looses in time. The reason that the trolley moves so hard is that the chain which carries the load must be "overhauled," and as the shives are comparatively small, a great deal of energy is necessary to pull the trolley along to do the "overhauling."

The same difficulty is encountered in moving the bridge in certain directions. When the bridge is central on the hoist and we wish to move it one way or the other, we are obliged to lift the total weight on the hook through a certain distance. The distance is proportional to the versine of the angle made by the hoisting chain with the vertical line. As the versine increases with the angle, of course we soon come to a point beyond which it is impossible to go. A movement of the bridge through a distance of five feet on each side of the center is usually all that is allowed. The angle which the hoisting chain would make when beyond this distance is also an objectionable feature.

The moment the crane valve is open, the water rushes into the hoist at such a high velocity that it is impossible to get a fine adjustment of the hook. This, of course, is an important thing, as the center line of a rivet should always be central with the dies; otherwise the rivet will be driven with the head out of center, which is bad practice. Then, too, there is another class of work which must be done on the riveting machine, namely, that of driving the rivet in diametrical seams. For this work the boiler should be supported at a constant height. As there is always more or less leakage about the gland, connections, etc., the hook will gradually settle, and thus every now and then it is necessary to raise the boiler a little before being able to go on with the work.

With the electric crane most of these objectionable features disappear. The vertical adjustment of the hook can be made as fine and delicate as desired. Once a load is brought to a certain height, it will not settle, no matter how long we are working on a row of rivets. As an automatic brake is provided on all electric cranes, it is impossible for the load to drop when the source of supply is cut off. In a hydraulic crane if the pipe becomes broken by an accident of some kind or other, the load on the crane hook will drop. With the electric crane it is possible to have power traverse for either the trolley or bridge or we may have power traverse for both of them. As we do not have to "overhaul" any chain, and as we are not obliged to pull against the hoisting chain, either one of those two movements can be made by hand without much effort.

As the size of the locomotive boiler is constantly being increased to meet the strenuous requirements of modern railroad practice, the diameter of the rivets is also increased. This requires riveting machines of large capacity. To-day we are using machines of 150 tons capacity, while five years ago machines of a hundred tons capacity were rare, even in the most up-to-date shops. These large machines take up considerable room and as the size of the riveting tower has been settled upon and built several years ago, we are obliged to place machinery in a small space. If the hoist is located directly back of the riveting machine, which is the best place for it as far as operation is concerned, the riveting machine is thus pushed so far away from the side walls that the stake stands in the center of the tower and thus occupies the room which otherwise could be used by another machine.

This difficulty comes up in the installation of almost every new plant. It is overcome to some extent by placing the hoist to one side or the other of the riveting machines, and then leading the crane chain over an idler shive. This makes an expensive arrangement for the reason that the tendency of the crane chain is to lift this shive and foundation out of the ground. A very heavy foundation therefore becomes necessary, and this is expensive. Besides this, there is also a heavier foundation required for the hoist. Then, too, it is not good engineering to deflect the chain any more than is absolutely necessary.

In order to get the most economical arrangement of the machinery, no matter what arrangement of the hydraulic hoist is used, it is necessary to juggle the machinery around until one is led to believe that a satisfactory arrangement is obtained. A drawing if then made and submitted to the customer. After considerable correspondence, and after alterations have been made, an arrangement of the machinery which is not at all economical in regard to the space occupied must be accepted. If the electric crane were used instead of the hydraulic hoist, the difficulty would be overcome in a very short time and at the same time we would be able to get any required amount of traverse on either side of the central line of the riveter. The increased traverse would enable us to pick up a boiler on one side of the riveting tower and then carry it across the tower to the machine where the boiler is intended to be riveted.

The cost of the crane, whether hydraulic or electric, would naturally resolve itself into installation, operation and maintenance. The cost of an electric crane equipped with power traverse for the trolley and the bridge will just about equal that of the trolley chain and hoist, while the cost of an electric crane with hand traverse will be somewhat less than the hydraulic equipment.

The cost of operating the electric crane is so much lower than that of the hydraulic that it is almost unnecessary to make any comparison. The power consumed by any electric motor is very closely proportional to the amount of work performed. This is important for the reason that a great deal of raising and lowering becomes necessary in order to gain certain ends. Thus, when a boiler lays flat on the ground it must be handled by two cranes in order to up-end it. One of these cranes has very little load, but considerable motion.

In the general run of work on riveting machines there is a great deal of light work handled, and of course economy on the part of the crane for handling this work would be an item of considerable importance.

The maintenance of hydraulic machinery will be cheap or expensive depending largely upon the care it receives. A failure to drain the cylinder in cold weather may result in a broken cylinder. Broken shives, crane pinions, etc., are not at all uncommon items of repair. With the electric crane the cost of maintenance is less, as there is little chance for anything to get out of order and there is less danger to the motor from the neglect of the riveting crew. The controller and the crane equipment would receive their usual inspection with the rest of the electric machinery of the shop, this being given by the electrician of the plant.

In conclusion it might be mentioned that electric cranes have been used in several boiler shops to advantage in a number of ways. The greatest advantage has been in the economy of room and of operation.

The Large Switchboard at the St. Louis Exposition.

THE great switchboard extending entirely across the central bay in the west end of the Machinery Building is designed for the control of all the 6,600-volt, three-phase current used on the Exposition grounds. This switchboard is a brick masonry structure occupying two galleries and supported upon timber work, as shown in Figs. 1 and 2. Fig. 1 is a cross-section and Fig. 2 is a longitudinal section, the latter showing different exposures of the switchboard structure.

This switchboard consists mainly of feeder panels, as most of the generator panels will be located near the machines they control. The four generators in the service plant have control panels on this switchboard. There are in all 17 feeder panels, 4 generator panels, 3 total load panels, 3 exciter panels, 2 incoming feeder panels from the Union Light & Power Company, and one rheostat panel for controlling the water rheostats spoken of as being inserted in the Union Light & Power Company's feeders at the entrance to the grounds for the purpose of bringing the decorative lighting up to full voltage gradually. Fig. 3 shows the layout of the control board proper, which is on the second floor of the gallery, and which has nothing but low-tension pilot circuits upon it. Before going into the details of the construction of this board, it may be well to understand the general scheme of connection. Fig. 7 shows in its simplest form the connection of one feeder to the bus-bars. There are two sets of three-phase bus-bars on the board, which are designated as *A* and *B* in Fig. 7. Each feeder can be connected with either the *A* or the *B* bus-bars through the medium of a Westinghouse solenoid operated oil switch. On each side of the oil switch, as indicated in Fig. 4, there is a hook knife switch, so that the oil switch could, if necessary, be entirely disconnected, both from the bus-bars and from its feeders, in case it should be necessary to make repairs on the switch. These switches can be operated either by a low-tension hand switch on the controlling board or by an automatic overload relay. Referring again to Fig. 1, it will be seen that the two sets of bus-bars are located in independent brick compartments about 9 ft. apart, one row of compartments occupying the rear part of the lower gallery and the other row the front part. On the second gallery is located the control switchboard and the high-tension oil switches.

The construction of this board is being carried out in a very thorough manner, as the handling of such a large volume of 6,600-volt current makes it inadvisable to employ anything in the way of a makeshift as a switchboard. As a consequence, the construction of this switchboard has been a very large and important undertaking; in fact, the largest single item in the work of the electrical and mechanical department. The actual construction of this board has been under the direction of Kerson Nurian. The general design of the board was worked out by the electrical and mechanical department in conjunction with the Westinghouse Electric & Manufacturing Company.

The accompanying drawings give a better idea of the construction of the switchboard than can be conveyed in words. It is only necessary to call attention to a few features that may not be evident at first glance from the drawings. As seen in Fig. 1, the hook knife switches, which are placed in the circuit on both the incoming and outgoing leads from the oil switches, are located on a concrete partition just back of the oil switches. The eighth panel from the right-hand end, Fig. 2, shows the arrangement of these hook switches and the feeder leading thereto. Following the right-hand leg of the feeder as it leaves the three conductor lead-covered cable at the bottom of the board, it can be seen that it passes up through two series potential transformers, which are used in connection with the switchboard instruments, and then up to the right-hand hook switch. From this switch it goes through the concrete partition to

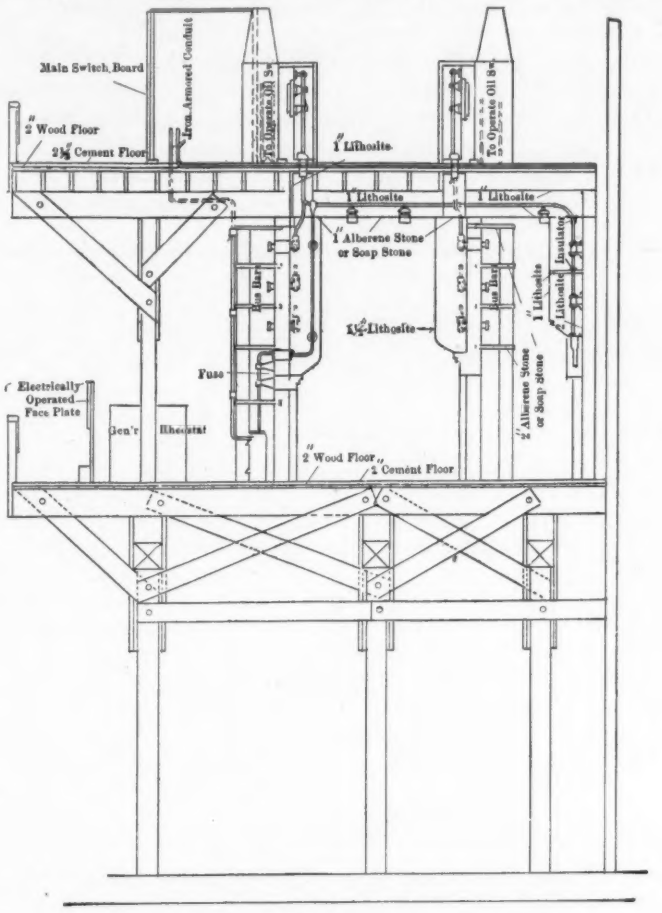


FIG. 1.—CROSS-SECTION OF MAIN SWITCHBOARD.

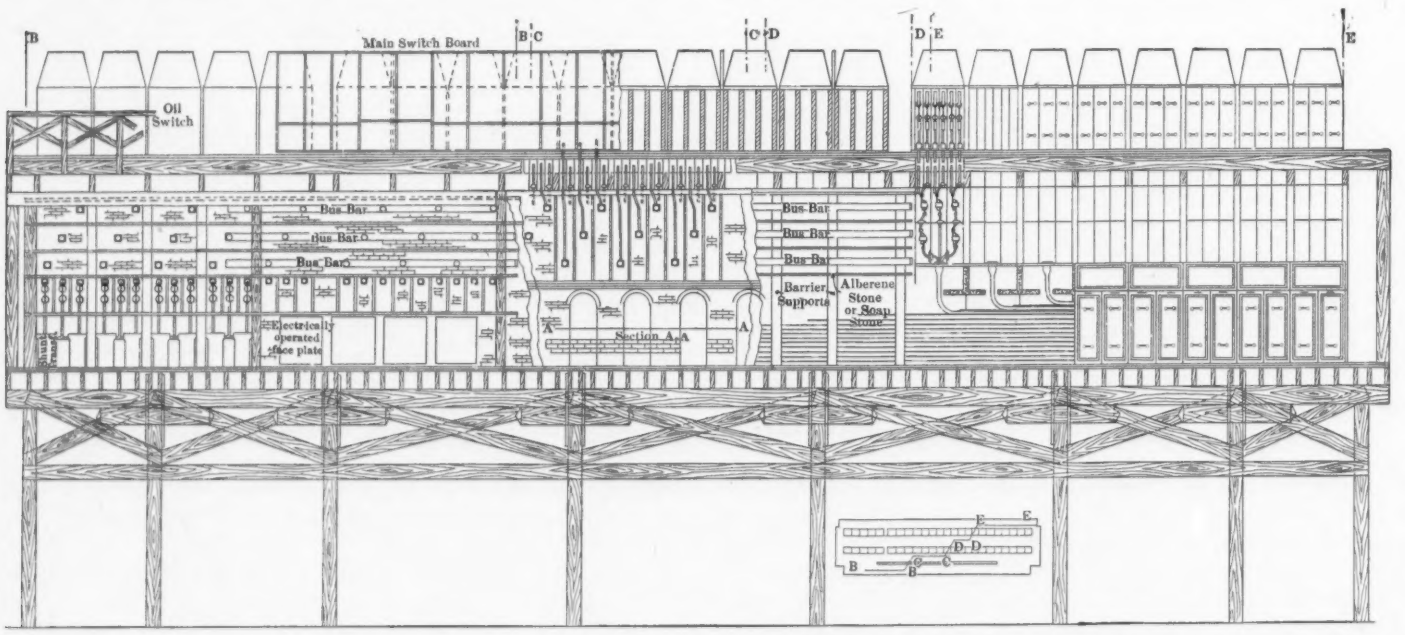


FIG. 2.—MAIN SWITCHBOARD, LONGITUDINAL SECTION OF OIL SWITCH AND BUS-BAR GALLERIES.

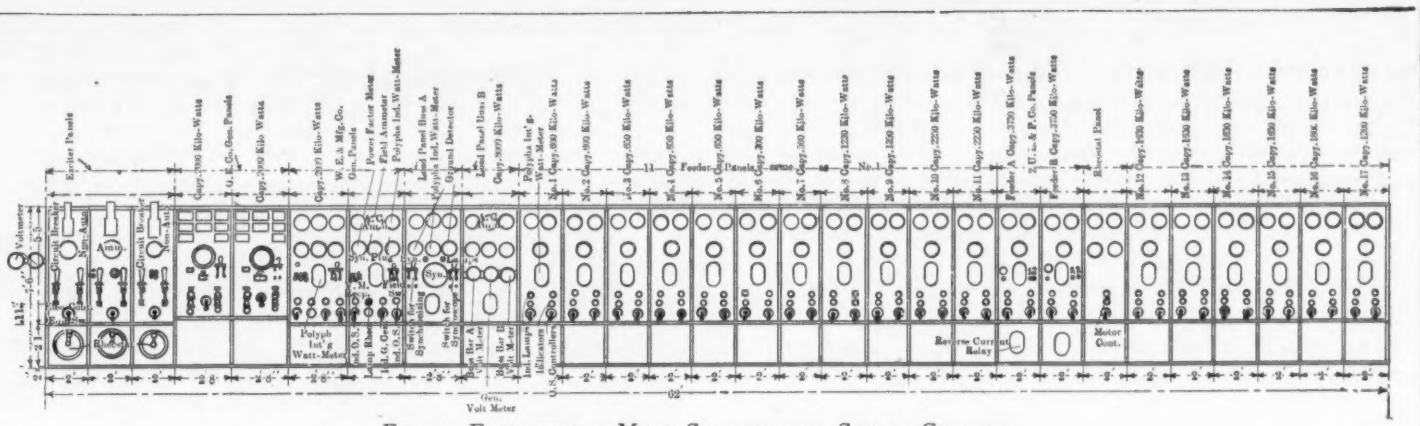


FIG. 3.—ELEVATION OF MAIN SWITCHBOARD, SECOND GALLERY.

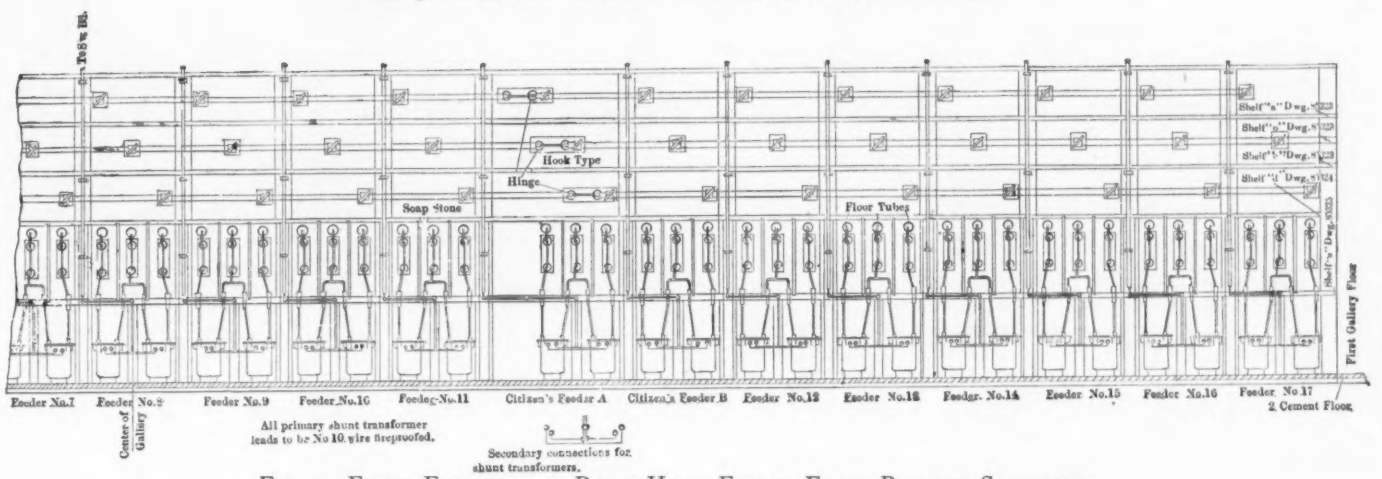


FIG. 4.—FRONT ELEVATION OF RIGHT-HAND END OF FRONT BUS-BAR STRUCTURE.

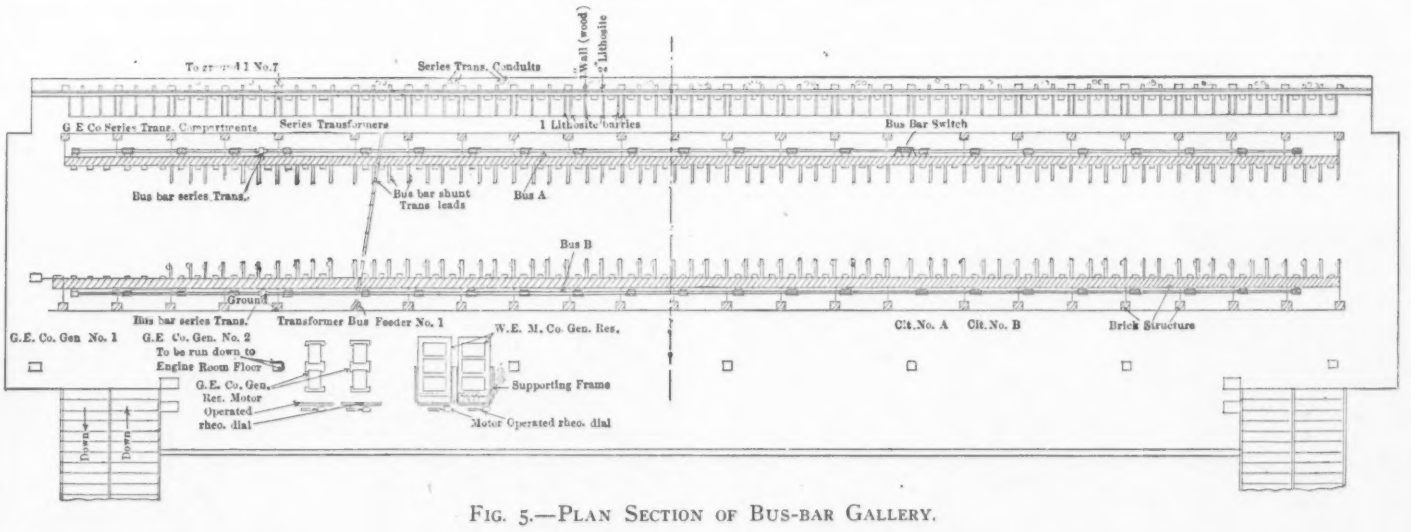


FIG. 5.—PLAN SECTION OF BUS-BAR GALLERY.

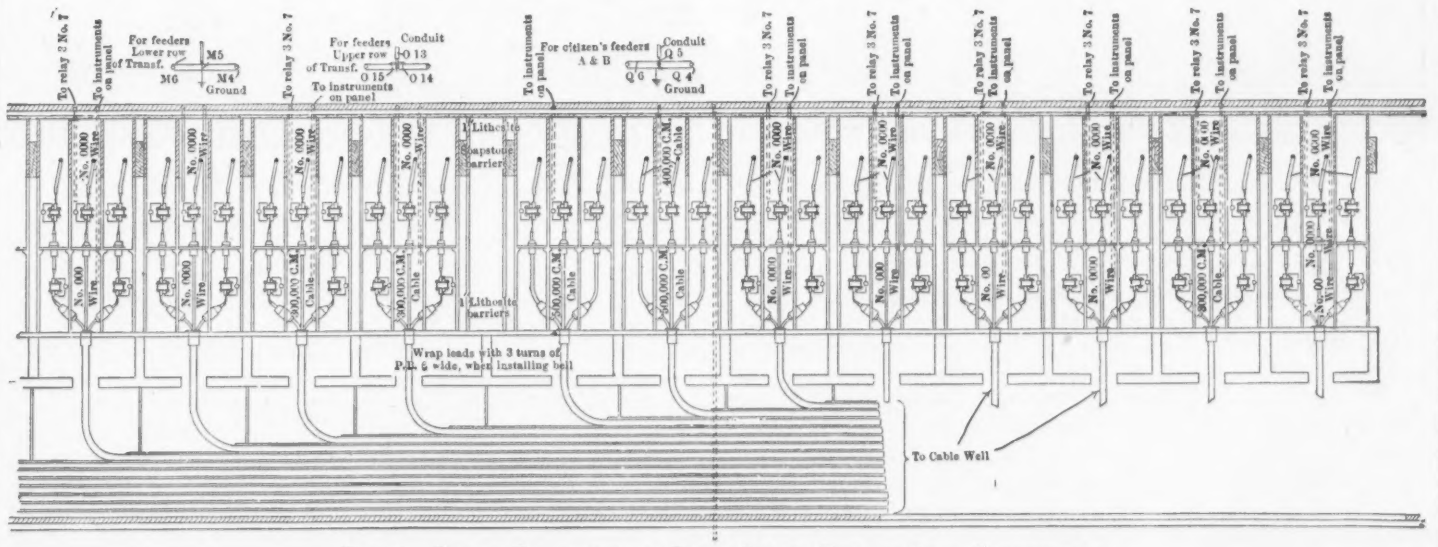


FIG. 6.—FRONT ELEVATION OF RIGHT-HAND END OF REAR CONNECTIONS.

SWITCHBOARD AT THE ST. LOUIS EXPOSITION.

the oil switch, through one leg of the oil switch and back to the hook switch adjacent to the one through which it entered; then down from the hook switch to the bus-bars. All holes where wires pass through floors have Thomas porcelain bushings set in slate blocks with sulphur. The solenoid operated oil switches are provided

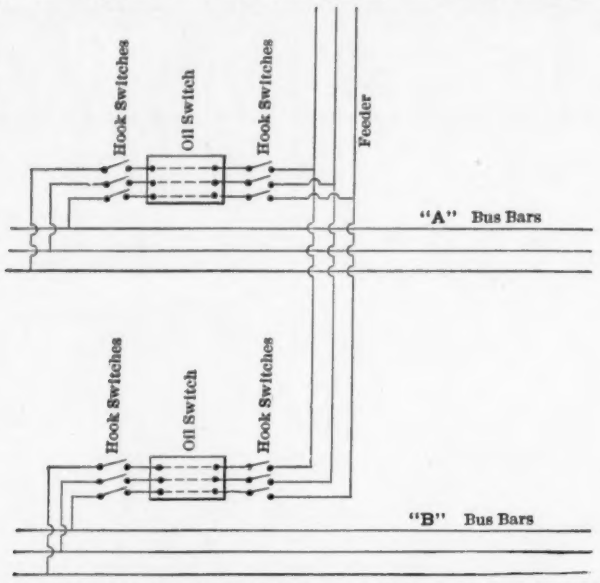


FIG. 7.—DIAGRAM OF CONNECTIONS OF A FEEDER TO THE BUS-BARS.

with concrete dividing walls, which separate the three legs of the circuit. On these switches the solenoid, when energized, draws the switch shut against the tension of a powerful spring. This spring is held closed by a trigger, and this trigger is released by a small magnet when the switch is to be opened. Each bus-bar consists of two flat copper strips. The bus-bars are separated from each other by soapstone slabs. The insulators upon which the bus-bars are mounted are set in soapstone plugs in the wall. All the low-tension control circuits to the switchboard proper are run in iron-armored conduit. Lithosite has been made use of freely to protect the bare connections on the wall back of the bus-bars, and where the high-tension cables run under the floor between the first and second galleries. The arches shown in Fig. 2 in the brick work just above

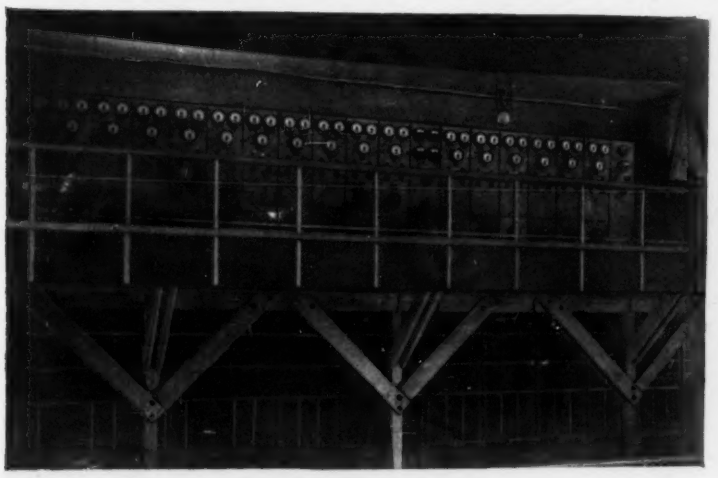


FIG. 8.—THE SWITCHBOARD.

the first gallery are for the purpose of reducing the weight of masonry on the wooden supporting structure. The instruments to be placed on the various switchboard panels are indicated in Fig. 3.

In Fig. 4 is shown the front elevation of the right-hand end of the front bus-bar structure, together with the location of the shunt transformers used on the switchboard. From this it is seen that the bus-bars are divided by hook switches, so that one section can be cut off from an adjoining section. The other end of the switchboard is similar to this as far as the bus-bars and partitions are concerned; the rear bus-bar structure is practically the same as the front.

Fig. 5 is a plan of section of the bus-bar gallery, showing the location of the soapstone barriers between the branches leading to the switches and the bus-bars on the opposite side of the partition. The bus-bars on one side of the partition are separated by horizontal shelves of soapstone, and the leads to the switches and hook knife switches on the opposite side of the partition are separated by vertical soapstone barriers. Fig. 6 shows the elevation of right-hand end with rear connections. A large number of feeders run to a cable well at the west end of Machinery Building, where they are led down to a vault, from which underground conduits radiate to

FIG. 9.—SOAPSTONE SEPARATORS.

various parts of the grounds. Perspective views of the switchboard, oil switches, etc., are shown in Figs. 8, 9 and 10.

Aluminum Electrical Conductors.

Before the recent convention of the Canadian Electrical Association Mr. R. I. Parke presented a paper having the above title, in which he discussed several practical matters relating to aluminum conductors. It is stated that observations show that sleet adheres

FIG. 10.—OIL SWITCHES.

much less readily to aluminum than to copper, and this is attributed to the coating of grease left on the surface of the aluminum during the process of drawing. The difficulties encountered in making joints in aluminum may be overcome in several ways. For joining aluminum wires smaller than No. 4/0 B. & S. gauge, the two ends are inserted into a piece of flattened tube and the tube given 2½ twists, thus making a low-resistance joint as strong as the wire joined. Larger sizes may be joined by means of the ordinary dovetail cable splice, by means of terminals compressed on the ends of the cables at the factory, these terminals being threaded and thus adapted to be united in the field by a threaded stud, or the ends to be joined may be inserted into cast sleeves which are compressed between dies in a small portable press. Taps are made by means of aluminum clamps, of which one carries a lug into which the tap wire is either soldered or secured by set-screws.

Annual Convention of the Canadian Electrical Association.

The fourteenth annual convention of the Canadian Electrical Association opened on Wednesday, June 15, 1904, in the Assembly Hall of the Hotel Royal in the city of Hamilton, and continued in session until Thursday at 6 P.M. The attendance was very gratifying, including as it did the leading central station men of British America, with a considerable contingent from the United States.

The chair was occupied by the president, Mr. L. J. Wright, manager of the Toronto Electric Light & Power Company. Mayor Morden welcomed the convention to the city of Hamilton and said that he was gratified to extend to them the freedom of what the citizens of Hamilton are proud to believe is one of the most progressive and prosperous industrial and commercial centers of the whole Dominion. He congratulated the organization on the success that it has hitherto attained and wished it every prosperity in the future; he also regretted that their stay was of such short duration, and he hoped that they would carry away with them to their respective homes pleasant recollections of their brief visit to Hamilton and that many future sessions would be held in that city.

President Wright then read his annual address to the convention and in it he referred to the great development that the Association had made in the twelve years since its previous meeting in Hamilton. Although then recognized as the Birmingham of Canada, it had not attained the distinction it now enjoys as the Electric City. He referred to the favorable hearing accorded to the deputation that waited upon the Minister of Inland Revenue a few weeks ago and thought that a further application would secure increased facilities for the protection of their work. The president dwelt at some length upon the cause of the many fires continually taking place, and said that laying the onus of fires upon the electric wires where there is no other obvious explanation had become now the fashion, and that the insurance companies by their readiness to accept the wire theory were simply encouraging incendiaries. In conclusion he expressed the hope of seeing the Association become even a greater power in the land and under the guidance of the younger and more energetic of its members it should become something more than an ornamental name. The report of the secretary-treasurer, Mr. C. H. Mortimer (Toronto), showed an increase in the membership of the Association of thirty-one members over last year and a balance of cash on hand of $842.65. The report of the Committee on Legislation for the Province of Ontario showed a deficit of $131.97, and it was suggested by the president that this deficit should be looked after in some manner by the Association.

An interesting paper was read by Mr. E. B. Walker on "The Origin and Development of Storage Batteries," in which the writer traced the development in this line from the time of Gauthert in 1801. Mr. W. L. McFarlane read a most instructive paper on "Alternating vs. Direct-Current Arc Systems," in which he said that for reasons apart from arc lighting the tendency at present in equipping electric power stations is toward the installation of alternating-current generators of large capacity. The source of power may be water or steam, or a combination of both; that when, as is often the case, a combination of engines and water power has to be used, transformers and lamps, or motor-driven arc dynamos are possible as in the other two cases, there being also possible the arrangement whereby the arc dynamos are operated from line shafting to which are connected both an alternating-current motor and an engine; by means of suitable clutches or quills, either the motor or the engine being used to supply the necessary power to the shafting. Generally speaking, there are four systems of series arc lighting at present in use, as follows: (1) The small arc dynamo supplying about 50 open lamps at 9.6 or 6.6 amp. (2) The larger and more modern arc dynamo supplying as many as 175 open lamps in series or by the multi-circuit arrangement. (3) Large arc dynamos wound for 6.6 amp. for supplying current to enclosed lamps. (4) Transformers to which are connected circuits having as many as 100 constant-current, series-alternating, enclosed arc lamps.

The maximum candle-power of the open arc is higher than that of the enclosed arc, but the light is not so steady owing to the more frequent feeding of the carbons, their poorer quality, and the action of the wind on the arc. Owing to the shortness of the open arc, and to the fact that most of the light comes from the crater of the upper carbon, this light is in a downward direction, being greatest at an angle of about 45°, while a large area under the lamp is poorly lighted and affected by shadows. In the enclosed arc the wandering of the arc is the main cause of what variation there is in the light, but by the use of an opal inner globe these variations are greatly reduced. The increased length of the enclosed arc allows the light to diffuse in a more horizontal direction, the result being much less light in the immediate vicinity of the lamp, but a slightly increased amount midway between lamps.

A comparison of the light given by the two enclosed arcs, namely, from the direct-current and the alternating-current lamps, will show that the former gives slightly more light at all points than the alternating lamp, although the alternating lamp gives more light than the open direct-current lamp midway between lamps. It is claimed that the difference in the light (at, say, 150 ft. from the lamp) between the direct-current and the alternating enclosed lamps is nearly, if not quite, compensated for by the more subdued light in the vicinity of the latter lamp increasing the relative effect of the light at a distance by reduced contrast. Whether this is so or not, the fact remains that the light given by the alternating lamp is apparently less than that given by the open direct-current lamp, and the apparent reduction in illuminating power is a very difficult point to explain satisfactorily to the municipal authorities or the public in general. It is only fair to say, though, that where an old-style open direct-current arc system has been replaced by a modern alternating enclosed system, it is rare to find any serious opposition, especially if the new system is properly handled and maintained. The possibility of such trouble need not deter anyone from installing modern equipment of this type if other conditions indicate that it is advisable to do so.

A paper entitled "The Curtis Steam Turbine," by Mr. Frank C. Smallpiece, gave an historical account of the steam turbine and a description of the Curtis type.

A paper on "Aluminum Wire as a Conductor" was presented and read by Mr. Roderick J. Parke, E.E., of Toronto. Mr. Parke also exhibited samples of aluminum and copper wire showing the methods of joining the ends of the wire.

Mr. P. M. Lincoln read a paper on "Heavy Electric Traction by Alternating Currents," in which it was predicted that the steam locomotive is doomed to extinction, and that electricity will take the place of the steam locomotive in through service on trunk lines just as it has replaced the horse as a motive power for local service on urban and suburban lines.

Mr. K. L. Aitken gave an interesting and instructive talk on "The Niagara Power Development," showing by lantern slides its progress since the inception of the work.

Mr. George Johnson, Dominion statistician, read a paper on "The Statistics of Canadian Progress in Electrical Applications," in which the writer said that on land there are 1,025,700 miles of line and 3,978,500 miles of wire, representing an outlay of capital equal to $500,000,000, and adding the outlay for cables there is a total outlay of $850,000,000 to provide the means for transmitting wire messages by sea and by land. Over head and under seas there is a daily transmission of 1,400,000 telegrams and 36,000 cable messages, the annual totals in 1903 being 478,330,000 land messages and 13,140,000 cables. The countries which most use telegraphic communication are the British Empire, the United States, Germany, France and Austria-Hungary. The British Empire has 218,000 miles of line, nearly 1,000,000 of wire, and sends and receives 127,000,000 messages.

The "Question Box," edited by Mr. A. A. Dion, of Ottawa, created a great deal of interest and brought to that gentleman a well-merited vote of thanks from the Association for the time and trouble devoted by him to preparing the questions and securing the answers in the published volume of the Question Box.

On Thursday afternoon the election of officers took place, which resulted as follows: Mr. K. B. Thornton (Montreal), president; Mr. A. A. Wright, M.P. (Renfrew), first vice-president; Mr. Geo. Black (Hamilton), second vice-president; Mr. C. H. Mortimer (Toronto), secretary-treasurer. The Executive Committee consists of Messrs. A. B. Smith, Gordon Henderson, J. A. Kammerer, John Murphy, J. J. Wright, A. A. Dion, B. F. Reesor, C. B. Hunt and Fred Thompson.

After passing the customary votes of thanks, three hearty cheers were given for the retiring president, Mr. J. J. Wright, whose modesty was seriously disturbed by the singing of "He's a Jolly Good Fellow" and "See Him Smiling." Mr. Wright thanked the Association for its very hearty cheers. The convention then adjourned to meet in 1905 in the city of Montreal.

High-Tension Transmission Meeting of the American Institute of Electrical Engineers at Chicago.

THE High-Tension Transmission Meeting planned by the Transmission Committee of the American Institute of Electrical Engineers was held at Chicago June 21 and 22, 1904. President Bion J. Arnold called the first session to order Tuesday morning, June 21. The first paper read was on "Line Construction with Steel Supporting Structures and Long Spans," by F. O. Blackwell, consulting engineer. In addition to the paper as it appeared in the *Transactions*, Mr. Blackwell presented some drawings of steel tower construction.

Mr. Blackwell's paper was immediately followed by that of W. G. Carlton, assistant to the chief operating engineer of the Chicago Edison Company, on "The Protection of Cables from Arcs Due to Failure of Adjacent Cables. The discussion of the two papers was then taken up.

Mr. O. E. Osthoff inquired whether Mr. Blackwell had discovered any varying inductive effects due to the sway of the cables on long spans. In reply Mr. Blackwell said that nothing of the kind had been noticed.

Mr. Ralph D. Mershon assumed that Mr. Blackwell's figures of a life of five to twenty years applied to the poles only, because there was no reason for supposing that the other parts of a transmission line would have such a short life. He inquired as to whether there had not actually been lightning troubles on the existing steel tower line. In his experience there was less trouble from insulators than anything else on a transmission line. Most of the troubles were from short-circuits caused by throwing things across the line and by the burning off of poles by forest fires. Most of the insulator troubles occurred when the line was new; after the poor insulators were weeded out insulator trouble became very small. Sometimes considerable trouble was experienced from the shooting away of the insulators by cowboys and others. This practice could usually be stopped if the offenders were appealed to in the right way. He mentioned one case where a line which crossed a large cattle ranch was frequently troubled by the shooting of insulators. After the cowboys were appealed to by the line inspector and brought to know that as mining machinery was operated from the transmission line there was always a possibility that a breakdown of the line would cause the death of some one, no more trouble was experienced. In discussion of Mr. Carlton's paper he said that he thought the protection of cables inside the power station was fully as important as their protection outside the power station. He preferred the use of tile to asbestos for cable protection in manholes, because asbestos is such a poor conductor of heat.

Mr. Blackwell, in answering Mr. Mershon's question as to whether or not there was trouble from lightning on the Guanajuato steel tower transmission line, said that some insulators had been broken. which they thought was perhaps due to lightning, but had no definite means of knowing. At present rods were being put up so as to extend above the transmission line and virtually make a lightning rod of the steel tower. Perhaps the melting of the sleet by the I^2R loss in the wire could be depended upon ultimately to keep sleet off, although there was always the chance that a transmission line might be shut down by an accident at the time of a sleet storm, in which case the sleet would be allowed to accumulate.

Mr. W. F. Wells, of the New York Edison Company, in discussion of Mr. Carlton's paper, told of the precautions his company had taken to have each sub-station fed by feeders running through at least two entirely separate conduit lines from the power station to the sub-station. Low-tension cable troubles were sometimes communicated to the high-tension cables. They had used the asbestos wrapping for cables in manholes spoken of by Mr. Carlton. Inside of stations he favored running cables in tile ducts or brick runways.

Mr. Mershon said that the expense of running two separate subway lines over different routes did not necessarily involve a greater cost than the placing of cables in one subway. The heating of the cables in a conduit due to resistance losses would limit the current density in the central cables of a large conduit, so that possibly it might be more economical to have two conduits, and get more chance to conduct heat away.

Mr. Carlton replied that the cost of repaving was so large a proportion of running conduit lines that it would in most cases make the single conduit line cheaper than the double line. He gave some figures on the energy radiated per duct foot in the Chicago Edison Company's practice. He said there had been instances where cables had been run so hot that the gas distilled off from the insulation created pressure enough to puncture the lead sheath. He agreed with Mr. Mershon that protection for cables in the power house was as important as protection outside the power house. He thought open work should be avoided as far as possible with high-tension cables. His company grounded the lead sheath at power house and substations by connecting to the brass bell at the end of the cable sheath. As to the relative reliability of overhead and underground high-tension lines, he gave some figures from his experience, which seemed to show much more trouble with overhead lines than with underground lines per mile of line.

Mr. H. B. Alverson, of Buffalo, said that if cables were wrapped with asbestos at the manholes a saturation of the asbestos with silicate of soda would add to the heat-conducting properties of the asbestos and so overcome the objection against asbestos that had been urged, that it confined the heat to the cable.

Mr. A. S. Hatch, of Detroit, gave some data on steel towers used for public lighting in Detroit. Towers 161 ft. high had been in use in Detroit now about twenty years. The greatest trouble experienced had been the buckling of the legs of the tower and rusting of the pipe threads. The towers appeared to be good lightning conductors. At the bottom of each tower was a cut-out switch for the lights on the tower. The case of this switch was grounded to the iron work of the tower. During severe lightning storms these switches were frequently burned by discharges jumping across from the live parts to the case.

Mr. Charles F. Scott said that steel tower construction for transmission lines was mainly a problem in mechanical rather than electrical engineering. Steel tower construction removes all the principal causes of trouble found in present transmission lines, and the elimination of such troubles is the principal object to be attained in steel tower construction.

Mr. Blackwell, in response to a question, said that no direct evidence of lightning had been found on the steel towers which would compare with the shattering of wooden poles by lightning.

Mr. W. L. R. Emmet related in detail some observations he had made on an electric railway pole line on the Kansas prairies some years ago, where lightning struck several of the poles on the line. The two poles nearest the lightning discharge were splintered into matchwood. Four or five poles each side of the completely splintered poles were struck, but not destroyed, and the trolley wire insulators on them had the appearance of having been exploded. Beyond these poles for four or five poles the trolley wire insulators were simply punctured. No trolley wire insulators were injured more than a quarter of a mile either way from the place where the poles were struck and no knowledge of the event was given by the power house instruments or apparatus. Mr. Emmet drew from this the conclusion that the self-induction offered by even a straight overhead line might be so great as to prevent the discharge following the wire very far, and he thought that steel poles might have a value in relieving transmission lines from lightning discharges because of the self-induction offered by the transmission line itself.

Mr. Blackwell, in replying to a question as to the comparative cost of a wooden pole as against steel tower construction for a 60,000-volt line, said the cost of a steel tower construction was about equal to that of a wooden pole line if the wooden poles cost $10 each. This would make the steel towers the cheaper in some cases where wood is scarce and shipment is very expensive. Furthermore, a single wooden pole line did not permit the separation of the wires of two different circuits so that repairs could be made on one circuit with the other circuit alive.

Prof. C. E. Freeman inquired as to imperfections in wire affecting its tensile strength, especially aluminum wire.

Mr. Blackwell said that putting aluminum in the shape of cable eliminates the trouble from breakage of single strands due to imperfections in single conductors.

Mr. H. C. Wirt inquired as to the effect of the grounding of the neutral wire on the working of the telephone circuit on the same pole line, and also spoke of such grounding prohibiting any repair work on live lines.

Mr. Blackwell said that the only detriment to the telephone circuit by such grounding might be that due to leakage of the high-tension current down a wooden pole. As to repair work, no one expected to do that on the highest voltage lines while the lines were alive,

so that grounding the neutral would not make any difference as to that.

Mr. Hoopes criticised the span and sag curves presented in Mr. Blackwell's paper, and cited an example of an aluminum span which had been erected for two years, and upon which the maximum sag between extreme hot and extreme cold weather was only 22 ft., as compared with 53 ft., which it should be, according to Mr. Blackwell's calculations. He also thought Mr. Blackwell assumed too extreme wind pressure. He cited Weather Bureau reports showing that a wind velocity of over 40 miles per hour was never observed with a temperature below 0° F. The maximum recorded velocity of wind in the United States was 68 miles per hour, so that 100 miles per hour was too high a figure to assume as an extreme condition unless a tornado was expected. No one had ever observed the wind velocity during tornadoes for obvious reasons, but it was thought to reach 300 miles per hour, and it was manifestly out of all reason to expect any pole line to be able to withstand tornadoes, so that they could be left out of the account in figuring maximum adverse conditions. As to sleet, he did not know that there was any limit to the amount of sleet that would collect on a wire, but most high-tension men did not think sleet would cause much trouble.

President Arnold asked if any members had data to present on the relative reliability of overhead as against underground transmission lines. He said this question had come up before the Engineering Board of the New York Central Railroad in connection with the electrical equipment of the New York terminal. They had come to the conclusion that overhead transmission lines were the best, not only because they were cheaper, but because they were more reliable.

Another question which had come up was as to the relative value of round vs. square conduit ducts. Some maintained that pebbles which would settle to the lowest point of a round duct might injure the lead sheath when the cable was drawn in, while the square duct would allow pebbles to be pushed aside.

The convention then adjourned for lunch and reconvened at 2 p.m., when a paper by M. H. Gerry, Jr., manager of the Missouri River Power Company, Helena, Mont., was read in Mr. Gerry's absence by Mr. Mershon.

John S. Peck, engineer of the transformer department of the Westinghouse Electric & Manufacturing Company, read his paper on the use of ground shields in transformers. Mr. Peck's paper did not advocate the use of ground shields in transformers, as he thought more effective protection was obtained by grounding the secondary circuit outside of the transformer. The discussion of both of these papers was then taken up.

Mr. Mershon, in discussing Mr. Gerry's paper, asked the experience of members as to the value of reverse relays for cutting out automatically short-circuited transmission lines when several lines were run in parallel. For some reason reverse relays had not been heard from much recently. He thought either a grounded secondary or a ground shield very necessary to the safety of secondary circuits. He favored grounding the neutral wire of the secondary circuit.

Mr. Wirt explained that the ground shield was devised before the underwriters had passed the rule allowing the grounding of secondary circuits.

Mr. Clark, of the Illinois Steel Company, cited several examples of the use of steel poles around steel plants where very substantial overhead construction was desired. These poles cost from $60 to $120 each, the cost being so great that their feasibility was questioned.

President Arnold said that the steel poles upon which the New York Central Board had been figuring were at first quoted at $200 each, but they had since got this price down to $80. There were places where a transmission line with four or five steel poles to the mile might cost less than a wooden pole line. On the Guanajuata line, for example, the cost was much less. Overhead construction had been decided upon for the bulk of the New York Central's transmission lines, both on account of the lower cost and on account of the quickness with which troubles could be located and remedied on an overhead line as compared to an underground line. The New York Central Commission, of which he is a member, had collected information from operating companies all over the country as to the number of breakdowns on overhead and underground lines. The evidence was so much in favor of the overhead lines that there was nothing left for them to do but to decide in favor of the overhead lines. The transmission would be at 11,000 volts and two three-phase circuits would be used.

Mr. Gonzenbach inquired as to the merits of a 35-ft. steel pole rerolled from scrap railroad iron upon which he had recently had quotations of $15 each delivered. He thought that a remarkably low price for a steel pole.

Mr. Clark said that the quality of rerolled rails would probably be all right, but did not see how such a pole could be made at the price of relaying rails. It was explained by a member that the steel used in the pole was scrap and not relaying rails, and hence was cheaper.

Mr. W. D. Ball said that the type of pole referred to, which was rolled in Franklin, Pa., could be delivered in Chicago for a little less than 3 cents a pound, a 30-ft. pole weighing 616 pounds.

Mr. Mershon pointed out the fact that the sag in cables between the steel towers on a line of this character brought the conductors as near to the ground as those on a wooden pole line, and that, therefore, if a malicious person cared to walk along a transmission line to the bottom of a span, it would be as easy to throw wires and sticks over the line as with a wooden pole line.

Mr. Carlton said that an overhead high-tension transmission line was practically limited to six wires, and that when more than the six wires proposed by Mr. Arnold were to be run in one line, as was frequently necessary in large cities, there was too much risk, as well as too much trouble in handling, to justify such overhead construction, and therefore underground construction was necessary.

Mr. Arnold said that one point in favor of the overhead construction was that trouble could be so quickly reached.

Mr. Scott, in answer to criticisms as to the cost of the steel tower construction for a transmission line, said that what Mr. Blackwell was seeking was not cheapness but reliability. The kind of transmission line described by Mr. Blackwell was not to be compared with the present order of transmission lines, because it was so much more substantial and reliable and, therefore, came in a different category. He cited a case where a 30,000-volt, 20-mile transmission line was planned, which was to cost only 4 per cent. of the total cost of the undertaking. The line was planned for two circuits on one pole line, and his recommendation had been to increase the expense and separate the circuits by adding another line of poles, rather than to add greatly to the risk of interruption by a very small per cent. saving in pole line construction. Steel tower construction was naturally applicable to long high-voltage lines, transmitting a large amount of power, and he understood that it was for this class of work that it was being proposed and not for small, unimportant lines.

Dr. F. A. C. Perrine agreed with Mr. Scott as to the reliability of steel tower construction on long lines. Steel towers he considered very much more reliable than ordinary construction. The insulator is the weakest member of the transmission line, and the number of insulators is reduced by the tower construction. He did not consider a grounded wire running along a transmission line to take static and lightning discharges to be a permanent and satisfactory arrangement. The steel poles might be valuable as lightning arresters. In general, any transmission line that spans the valleys is more reliable than one having poles where they are liable to be washed away. He cited a case with which he is familiar, where a transmission line with average spans of 300 ft. and a maximum span of 1,800 ft. had been in operation three years. This was on wooden structures, but would be more reliable with steel.

Mr. Clark, speaking of stranded cables for use on such lines, said that a soft asbestos center was sometimes used on cable. This would not stretch as much as the cable, and would break, leaving a portion of the cable without any core, with the result that the cable would flatten at these points. A soft iron wire core overcame this.

Mr. Mershon did not consider steel towers as a lightning protection the equivalent of a grounded wire run parallel to the transmission wires. There were cases where a company could not afford to put in tower construction on account of its high cost. He did not agree with previous speakers that it was not a question of cost. He thought it was altogether a question of what it cost to deliver power and what investment was justified.

Mr. W. B. Jackson, of Madison, Wis., favored wood pole and cross arm construction, because the leakage of an insulator would simply result in the burning of a cross arm and pole without interruption to service, while, on the other hand, a leaky insulator on a steel pole and cross arm would shut down the line until it was removed, and, further, that a short-circuit on an iron cross arm might burn off the cable at the point of short-circuit.

Mr. Alverson said that the short-circuit which would follow the

breaking down on an insulator on a steel tower line would cause the shutting off of current before time enough had elapsed to burn off the cables.

Mr. Wirt referred to the many obscure phenomena connected with lightning and urged the result of practical observation rather than theory as a basis for determining what is best in lightning protection.

Mr. Junkersfeld thought reliability in service of very great importance. The cost of the transmission line in large city systems is but a small per cent. of the total cost, so that there is little to gain by attempting economy in first cost at the expense of reliability in transmission lines. Assuming two three-phase overhead lines as against two three-phase underground cables, he thought the liability of the overhead line being disabled much the greater.

President Arnold said that the New York Central Engineering Board, after collecting information as to the comparative number of interruptions of service on overhead and underground transmission lines and the relative cost, was forced to the conclusion that the overhead was best. With the evidence they had collected from them, they could not decide otherwise. Any sane man would have decided the same way with such evidence. The cost of the underground construction was something like seven or eight times as much as the overhead, and the reliability was very much in favor of overhead construction.

Dr. Perrine sketched out a plan which he had once considered for a 350-mile line to transmit 25,000 kw at 60,000 volts. The line was to be supported on towers, and there were to be four lines, one of which was to be in reserve. Sufficient room was provided on the towers for repairing the reserve line without danger from the others. The top of the structure was housed over. This line had never been built, but was simply a proposed construction. In the Kootenay, British Columbia, transmission there were two independent circuits, side by side, on one of which the insulators had beeen housed, and on the other the insulators were left open. Experience there had not shown the housing to be a good thing, as the enclosed insulators collected dirt which is not washed off by the rain.

Mr. Neall said that steel towers would not do away with lightning protection at the station, no matter what value they might have along the line.

Mr. Blackwell thought that steel towers being usually located on the high points would act as lightning rods, as much of lightning trouble is likely to be on high points.

Mr. Wirt said that reports from one operating company which he had received said the grounded discharge wire was a great protection against lightning, and that the company using it on its lines had no lightning trouble, whereas another company in the same district had experienced much trouble.

Mr. S. B. Storer thought that barbed wire run along a transmission line to take static discharges increased the chances of trouble, not only on account of the great difference in voltage between the transmission lines and the grounded wire near them, but on account of static disturbances which they introduced.

Mr. Wirt questioned whether the commonly accepted idea that lightning arresters were needed simply to relieve static strains between the legs of a circuit and ground was altogether correct. There might be static strains between wires. That was indicated by the jumping across of discharges between terminals of apparatus where at least 100,000 volts would be necessary to cause such a jumping. Perhaps more attention should be given to line-to-line stresses. As the discussion had drifted toward the subject of Mr. Wirt's paper on "The Protection of High-Pressure Transmission Lines from Static Discharges," the paper was then read by its author, Mr. H. C. Wirt.

Mr. Neall urged more accurate keeping of records as regards the performance of lightning arresters and the number of discharges. The practice of inserting a continuous moving paper between the spark-gaps of an arrester to measure the number of discharges was a good one, if carried out. Definite records must be had before intelligent improvement in lightning arresters could be made.

Mr. Blackwell said that the trouble with lightning arrester experiments was that one must set the trap and wait a year for it to go off. It took a long time to get results from actual experience. He described briefly a water jet lightning arrester used in Switzerland, which consists in a small stream of water of high resistance playing continuously against the line. This closed the first day's session.

Wednesday morning a paper on "Synchronous Motors for Regulation of Power Factor and Line Pressure," by Mr. B. G. Lamme, was read by Mr Peck.

Mr. Blackwell expressed his long-continued interest in this general subject. He believed the first case where a synchronous motor was used simply for the correction of power factor was in a cotton mill in South Carolina, where there was a load consisting mainly of induction motors, and there was a large wattless current. It was desired to increase the capacity of the plant, and work the generating plant up to its full capacity. He recommended the installation of a rotary condenser (as he called the synchronous motor so used) simply for the purpose of improving the power factor and correcting the wave form. The use of this rotary condenser caused a reduction of 20 per cent. in the current, and greatly reduced the drop in voltage on the line. He also spoke of a 90-mile transmission in India, which was up to the limit of its line capacity to conduct current, and where a 1,000-kw condenser in the sub-station increased the capacity of the plant 50 per cent., without any other changes.

Mr. Lamme's figures showed that alternators designed to run at maximum possible speed were not the cheapest machines to build. Machines running about one-half the maximum speed permitted by the strength of the materials were preferable. The use of rotary condensers had assumed such an important place that on long lines it was not good practice to consider anything but 100 per cent. power factor, leaving the synchronous condenser to correct for lagging or leading current.

Mr. Waters said that, while it was formerly a rule to avoid induction motors and install synchronous motors as much as possible on long transmission lines in order to keep down the inductive load, which would cause a lagging current, the practice reviewed by Mr. Lamme made general use of the induction motor possible.

Mr. Gear mentioned a transmission system having 200 miles of 40,000-volt line upon which it took 1,000-kilovolt-amp. to charge the line at no load because of the capacity of the line as a condenser. After induction motors had started this was, of course, reduced. Here synchronous motors could be used to correct for the leading current as well as for any lagging current that might be set up when the line became more fully loaded.

W. B. Jackson suggested that where a steam plant is maintained as an auxiliary to a long-distance water power transmission, the generators driven by the steam engines could be disconnected when the steam plant was not in operation and these generators could be run as synchronous motors to change the power factor in any way desired.

Dr. Perrine said that Mr. Jackson's suggestion was important and had been extensively used. He mentioned the system of automatic compounding devised by Mr. Baum and put in operation in the steam plant of the Oakland Transit Company, which was being run as an auxiliary steam plant in connection with the Bay Counties transmission system. There were three motor-generator sets connected to engines and used to convert 60-cycle alternating current into 550-volt direct current for the railway. By varying the fields of the motor a correct power factor was maintained automatically. Details of the automatic compounding scheme were not given. Mines using induction motors and paying for power according to maximum current required found it a good investment to purchase synchronous condensers to reduce the wattless current as low as possible. He was surprised at the figure given in Mr. Lamme's paper that machines for this purpose would cost from 60 to 80 per cent. as much as similar machines for usual commercial conditions. He had known of prices as low as $4 per kw for high-speed machines and $10 per kw for ordinary machines. The discussion drifted into speed regulation with water power plants, and Mr. Blackwell told of a hoisting plant driven from a water power in Europe in which the hoisting plant was equipped with fly-wheel capacity sufficient to make two complete hoists. The fly-wheels were very high speed with a rim velocity of 20,000 to 30,000 ft. per minute.

Mr. Scott did not favor the use of a lot of small synchronous motors scattered over the system for purposes of correcting the power factor. He favored rather one large synchronous condenser near the point of consumption, the fields of which could be adjusted to meet the requirements. The proposition was applicable to large powers and long lines.

Mr. S. B. Storer thought that with a synchronous motor which would give a large current when short-circuited operating upon the line, the presence of such a motor would be a serious menace in case of a short-circuit on the line, because of the great volume of current it would give to the line as compared to the generators commonly used in transmission work, which do not give a large current upon short-circuit.

Mr. Mershon presented the report of the committee on high-tension transmission, which contained tabulated answers to questions relative to high-tension transmission from forty-six plants. The discussion on this was brief because of the nature of the report, which was mainly only a tabulated statement of the practice of different companies in various particulars.

The meeting then being open for a general discussion of any of the papers presented, Mr. Carlton again brought up the question of the relative reliability of overhead and underground transmission lines; Mr. Arnold's announcement of the adoption of overhead construction by the New York Central Railroad in New York having aroused considerable interest and private discussion among members. Mr. Arnold then made an explanatory statement to the effect that in ordinary city work conduits must, of course, be used, because they were generally required, and under city conditions were the most reliable, but for transmission lines on a private right-of-way the overhead line was the best. Troubles could be much more quickly located and repaired on the overhead line. He explained further that the small number of wires required on the New York Central installation brought the initial cost very high, and it would cost but little more to lay a conduit for a large number of circuits than for the two three-phase circuits proposed. The necessity of blasting the way for the conduit through solid rock further increased its proportionate cost.

Mr. Junkersfeld stated that the cost of the high-tension, 25-cycle transmission lines in central station work in large cities represented from 4 to 7 per cent. of the investment, so that there was no economy in saving at the expense of reliability.

Mr. Carlton asked for information as to experience with underground cables connected in series with overhead transmission lines.

Mr. Mershon mentioned a 17-mile transmission at 22,500 volts, 3,600 ft. of which was in three-phase cables underground and the balance overhead. There were four such cables. The line had been operating three years. Only one trouble had been experienced, and that was due to a defective cable joint. Choke coils and lightning arresters were placed at the point where the overhead line connected to the underground cables. The system was run Y-connected with grounded neutral. These connections were made in a terminal house at the end of the cable line in which were placed arresters and choke coils. The bells at the end of the cable sheath were of hard rubber instead of metal and were filled with paraffine. A number of lightning discharges had passed over the arresters.

Mr. Junkersfeld asked the experience of members with the ground net, which has been proposed as a requirement of the national code where high-tension lines cross over telephone and telegraph wires.

Mr. Schuler replied that they had been generally required in Europe, but were not successful and their use was being discontinued because when a wire breaks it is likely to jump over the net. The plan of running high-tension wires through a network of steel, forming a tunnel which completely surrounds the wires, was one solution of the problem.

Mr. Mershon said that protection was most needed because of the breaking of high-tension lines by sleet storms, and sleet storms would affect the protecting net as much as the high-tension wires, so that the net would have to be made extremely strong, if it was not as likely to break from sleet as the high-tension wires. He advocated placing poles near together at crossings and making them so high that, should a wire break near one insulator, it could not hang down far enough to touch the telephone wires crossing beneath the transmission line.

Mr. Storer mentioned a protection scheme used by the Utica & Mohawk Valley Railway, which was a net of steel span wires between poles, with wood cross pieces, the whole being insulated on high-tension insulators just as though it were a transmission line. He thought a grounded net would be better, thus avoiding a high potential on the net.

Dr. Perrine said that at the National Code Committee meeting the Underwriters' representatives were first in favor of netting as a protection, but after its drawbacks were pointed out, Mr. Mershon's plan of using high poles was suggested. This plan meant that when crossing a street 60 ft. wide poles must be used which would stand over 60 ft. above the neighboring telegraph and telephone lines. The final conclusions of that committee meeting were to recommend three methods. The first of these was to place the protection immediately above the low-tension circuit to be crossed rather than immediately under the transmission line. This can be done by placing grounded guard wires at the ends of the cross arms and a little above the level of the wires of the telephone line to be crossed and placing the transmission lines on a cross arm on the top of the pole on which the crossing telephone wires are carried. The second alternative plan recommended was that mentioned by Mr. Mershon, and the third was a grounded screen under the high-tension wires, of sufficient capacity to carry the maximum current in the high-tension circuit without overheating.

Mr. Storer inquired as to the practice in Switzerland of placing rings a short distance from the cross arm of sufficiently small diameter so that a wire breaking would hang down and touch the rings and so become automatically grounded.

Mr. W. B. Jackson said he had seen this plan used in Italy on the Valtellina Railway, which was originally equipped with these rings at crossings. They were being removed, however, because they sometimes grounded the line when there was no break of the wire. The rings would have to be very large and a considerable distance from the cross arm to avoid discharges from the very high-tension lines used in this country, which would almost prohibit their use.

As regards the effect of high-tension arcs in raising the voltage of high-tension lines above normal, Mr. Eastman, of the Chicago Edison Company, told of tests he had made on a three-conductor cable three miles long. One test was made with an oil switch and one with an air switch. The charging current of the cable only was broken in these tests. With the switch breaking the circuit in air, a voltage rise of 50 per cent. above the normal was obtained. Opening the circuit with the oil switch, it was possible to get but little rise above normal. These tests were made with a static voltmeter and were afterward checked by means of the spark-gap. The charging current of the cable was 3/10 of an ampere.

Mr. Alverson had tried putting a steam gauge on an oil switch when breaking a high-tension circuit. He got pressures of from 50 to 300 pounds per square inch in the oil chamber when oil was in the chamber. Removing the oil and making the break in the same chamber in air, the air pressure was from 15 to 20 pounds per square inch.

Mr. Eastman cited a case where an arc from the leg of a cable to ground had grounded that conductor and burned it in two without grounding the other two conductors, the other two remaining good for use.

Mr. Woodmanse gave some account of the Kalamazoo tests previously reported to the Institute by Mr. Steinmetz. These tests showed voltages upon opening the transmission line of three times the normal value of the line voltage. This was done by drawing arcs in air.

Mr. Carlton, in discussing cable protection, said that asbestos wrapping at the manholes was not intended as any protection for the cable itself in case an arc started in the cable, but was to protect the cable from heat generated by short-circuits in adjacent cables.

Mr. Junkersfeld, in answer to inquiries as to the value of static dischargers, thought that such devices on a large system were likely to start more disturbances than they prevent on a 9,000-volt grounded circuit such as the Chicago Edison Company operated. The fact was further brought out that the New York Edison Company used no such dischargers on their 6,600-volt, non-grounded circuits.

Mr. Scott quoted Mr. Buck, of the Niagara Falls Power Company, stating that on the Niagara transmission they left out all the safety devices possible because of the complications they involved.

Mr. G. R. Radley, of Milwaukee, said that static dischargers had been put on the transmission lines at Milwaukee, and troubles they had been having ceased. The neutral was grounded at the same time, however, so that they could not tell whether it was the grounded neutral or the static dischargers that relieved them of the trouble.

A discussion followed on the comparative merits of paper and rubber insulated cables for high-tension work.

James Lyman gave a number of examples where rubber-insulated cables had broken down after short service on account of the rapid deterioration of the rubber under high-tension stresses.

Mr. Woodmanse described some cable now being built with varnished cloth insulation for voltages up to 30,000. He also said that rubber insulation, especially if used bare on insulators around car stations, was likely to break down the insulators.

Between the morning and afternoon sessions on Wednesday President Bion J. Arnold invited the convention to a trip in the tunnels of the Illinois Tunnel Company on the electric freight trains. Mr. Arnold is consulting engineer for the proposed electric freight haul-

ing work of this company. A few experimental electric locomotives and freight cars are in use and the members were taken for a ride through some parts of the tunnel 40 ft. below the business streets of Chicago. The freight cars are at present hauled by electric locomotives, securing their traction from a rack and pinion midway between the track rails. The rack is insulated from the ground and forms a third rail, through which current is taken. Mr. Arnold announced, however, that the overhead trolley had been decided upon in place of this arrangement. The voltage on the trolley will be 250 direct current. Cars run on 56-pound steel rails laid to 28-in. gauge. Several types of cars have been built, most of which have removable sides and are arranged to dump without raising the trucks.

On Wednesday evening the convention was taken to a buffet dinner at the Chicago Yacht Club in the harbor, and after that to a moonlight excursion on the lake on the United States Steamship *Dorothea,* the naval training ship kept in service for the training of the Illinois Naval Reserve. Local entertainment at Chicago was provided through the kindness of the Chicago Edison Company, General Electric Company, Western Electric Company, Bullock Electric Manufacturing Company, Arnold Electric Power Station Company and Sargent & Lundy. The attendance at the meeting was very satisfactory considering that it was devoted to but a single department of electrical engineering.

Government Standardization of Electrical Pyrometers.

The National Bureau of Standards has issued a bulletin relating to pyrometer testing and heat measurements in which are contained the following instructions concerning thermo-couples and electrical resistance thermometers:

When pyrometers are submitted for test, it is highly desirable that the request for test be accompanied by a statement giving as far as possible the conditions under which the pyrometer is used (e. g., method of mounting pyrometer, depth of immersion, kind of bath or medium whose temperature is to be measured, how the pyrometer is protected, at what temperature it is used, and whether continuously exposed to these temperatures, etc.). A sketch showing method of use of instrument is often very useful. It is only when accompanied by such information that it is possible to realize approximately the same conditions in the test as in the actual use of the pyrometer and to make a statement as to the order of accuracy that may be attained. It also enables suggestions to be made as to desirable modifications in the use of the instrument that may lead to more satisfactory results.

In pyrometers of the thermo-couple type temperatures are measured by the magnitude of the e.m.f's set up between wires of different materials when one junction is exposed to the temperature to be measured and the other junction (or junctions) is kept at some known temperature.

Experience has shown that the most satisfactory couples for the measurement of temperatures throughout the range 300° C. (570° F.) to 1600° C. (2900° F.) are those made of an iridium or rhodium alloy of platinum fused to pure platinum, of which the most common type, known as the Le Chatelier pyrometer, consists of a 10 per cent. rhodium alloy joined to pure platinum. It is essential that the metals be pure and the alloy homogeneous.

For work in the interval, 600° C. to the temperature of liquid air or lower, copper-constantan (or iron-constantan) couples are available.

The complete test of a thermo-couple consists in a thorough annealing at white heat, determination of the e.m.f. of the couple at three or more known temperatures in terms of the standard scale of temperature of the Bureau, and the measurement of the resistance of the couple (when cold), with accompanying tables of corresponding e.m.f's and temperatures, and when the pyrometer-galvanometer is submitted a table will be furnished giving temperatures directly in terms of the readings of the galvanometer joined to the couple.

Electrical resistance thermometers are based on the variation of the electrical resistance of a metal (preferably platinum) with the temperature. When properly constructed and due precautions are taken in its use, the platinum thermometer is an instrument of great accuracy for the measurement of temperature from the lowest attainable up to about 1000° C. (1800° F.).

The complete standardization of a platinum thermometer includes a determination of its constants from measurements of its electrical resistance at three known temperatures—melting ice, steam and sulphur vapor. Where the platinum thermometer is to be used for measurements of temperatures below —100° C. (—150° F.), the boiling point of liquid oxygen will be used instead of the sulphur point. As usual, the bulletin gives a list of fees for testing and standardizing instruments submitted for such purposes.

Saving of Time by the Use of the Telephone.

In a brief discussion of the recent Census Office figures on the telephone exchange systems of the country, the New York *Times* says: "From the figures given it appears that in 1902 there were something more than five thousand millions of telephone messages exchanged in the United States. If it is assumed that half the messages sent were sent because it was merely convenient, there remain two thousand five hundred millions of necessary communications, of consequence as affecting the business or social activities of the American people. To find out how much time was saved we must assume an arbitrary average. On long-distance messages this might run into days for each communication. On nearby calls it might be but minutes. If we assume, as we may safely do, that the saving of time on each necessary communication in asking the question and getting an answer, or on imparting or receiving information, will average at least ten minutes by telephone over any other available agency of communication, we find that the saving on the two thousand five hundred millions of messages of the exigent and important class exchanged in 1902 was twenty-five thousand million minutes, or 416,666,666 hours, or 17,361,111 days, or 47,830 years.

If we allow 50 years for the maximum average of useful life, the 10 minutes' saving on each of one-half the messages of the 1902 telephone service would aggregate the entire lifetime for purposes of work of more than 956 able-bodied men employed as messengers. By as much as we should vary the assumed average saving of time per message our totals would increase or decrease. Probably ten minutes per message is far below the figure which would be warranted." Our readers can check such calculations by their own experience.

Combined Gas and Electric Properties.

Some very interesting statistics are brought out by that valuable annual "Brown's Directory of American Gas Companies," just issued for 1904. It appears that last year, 1903-4, there were 388 gas-electric companies, 556 companies making gas only, 210 natural gas plants, 140 acetylene town plants and 100 gasoline town plants. The 944 city gas plants are practically all the operating companies, and practically all the operating acetylene and gasoline town plants are given, but only one-sixth of the actual number of natural gas companies have reported, although this includes the principal ones. The grand total of gas companies and plants reported in the directory is thus about 1,400, counting each consolidation of a number of plants as one. The merging of companies has kept down the total number appreciably, as for example, the recent San Francisco consolidation; the Suburban Gas Company, supplying 18 towns, and the company at Ardmore, Pa., 11 towns; the South Jersey company, supplying 27 towns; the Public Service Corporation, supplying 50 towns; the Hackensack company with over 20 towns; the Philadelphia company, which operates and controls 16 companies and has a capital of $53,000,000, and many other cases might be cited which go to show that the number of companies does not always determine the importance of an industry. There are 4.5 pages of owning or operating syndicates, as compared with 3.4 pages in 1903 and 1.1 pages in 1899, showing the growing tendency in this direction. There is much of interest and value inside the vermilion covers of this recent compilation of gas statistics and it will repay careful study by those connected wth the industry. A few years ago about one-third of the American gas companies had electric departments; now the proportion has risen to about 45 per cent.

Meeting of New York State Independent Telephone Association.

The second annual meeting of the New York State Independent Telephone Association was held at Buffalo, at the Genesee Hotel, Buffalo, June 23 and 24, and was well attended, there being upward of 200 delegates and interested persons present. Among the prominent telephone men present were the president of the Association, Mr. George R. Fuller, of Rochester, who presided at the sessions of the convention; the vice-president of the Association, Mr. Howard Hendrickson, of Albany; secretary-treasurer, T. S. Lane, of Buffalo; Mr. B. G. Hubbell, of Buffalo; Mr. T. Harvey Ferris, of Utica; Mr. J. S. Brailey, Jr., of Toledo, Ohio; Mr. F. M. Potter, of Syracuse, members of the Executive Committee; Messrs. Fisher, of Grand Rapids, Mich.; H. W. Blake, of Naples; A. M. Taylor, of Penn Yan; H. D. Critchfield, of Cleveland, Ohio; Elgood C. Lufkin and Charles B. Hill, of Buffalo; J. G. Splane, of Pittsburg; W. D. Banard, of Philadelphia; Frank H. Mott, of Jamestown; A. L. Tetu, of Louisville, Ky.; W. L. Cary, Cleveland; Messrs. Warner, of Watertown; Wood, of Lowville; Otis, of Newburgh; Bernard, of Elmira; Griswold, of Albany; Kelley, of Newark; Brunson, of Geneva, and others.

The first session was held on the afternoon of June 23, President Fuller occupying the chair. The proceedings began with an address of welcome to the delegates from Councilman Stoddard, speaking on behalf of the Mayor, who was absent from the city. Councilman Stoddard cordially welcomed the Association to Buffalo, and among other things spoke of the great benefit to the city of Buffalo arising from the independent telephone movement in that city. He believed it had added largely to the welfare of the city, as well as to the convenience and comfort of its citizens.

President Fuller replied on behalf of the Association, thanking the Councilman for his cordial welcome, and referring to the fact that there were not less than thirty independent telephone companies operating in this State, having headquarters at Buffalo, and that it was, therefore, peculiarly appropriate that the meeting should be held in that city. He also stated that he anticipated that the time was not far distant when there would be a strong, prosperous independent telephone company operating in the city of New York itself. The president then proceeded to read a paper which he had prepared dealing generally with the history of the Association and its development, and the advances made in independent telephony generally throughout the country, the statement being made in the course of the paper that about 75 per cent. of the cities of the United States have independent telephone companies. He cited instances showing the wonderful growth of independent telephone companies in recent times. The report of the secretary, which consisted of the reading of the minutes of the last session, was next received, and the president then appointed the following committees:

Credentials—Mr. Johnston, of Buffalo; Mr. Warner, of Watertown; Mr. Potter, of Syracuse. Membership—Mr. Calhoun, of Buffalo; Mr. Wood, of Lowville; Mr. Otis, of Newburgh. Law, Legislation and Taxation—Messrs. Hendrickson, of Albany; Carey, of Buffalo; McDowell, of Elmira; Ferris, of Utica, and Bond, of Syracuse. Nominating—Messrs. Bernard, of Elmira; Griswold, of Albany; Warner, of Watertown. Auditing—Messrs. Kelley, of Newark; Brunson, of Geneva; Brailey, of Waterford.

The session then resolved itself into an experience meeting and many delegates spoke of their experiences in various sections, organizing and installing independent companies. Mr. B. G. Hubbell, connected with the Frontier Telephone Company, of Buffalo, was the first speaker. He spoke, in part, as follows: "We all believe in the independent telephone business. We all know it is the best business in the world. We all know that there is nothing that equals it financially. We know that we are dealing in a commodity for which there is no substitute. We know that we have but one competitor, and we are none of us afraid of that one. We know that we have all the business offered that we can take care of, and advance. I do not know of anything else that we ought to know to make the business a good business. Everything that is good in any line of business, to my mind, is embraced in the independent telephone business. Competition does not enter into it, as competition goes in other lines of trade, for the reason that the competitor that we have has his line of trade and we have ours; we have our subscribers and they have theirs. We get just as much money from them; they are with us just as long, as though we had exclusive privileges to the territory which we operate."

Mr. Hubbell was followed by Mr. J. S. Brailey, of Toledo, Ohio, who spoke of the desirability of having definite and binding contracts with companies with which long-distance connections were made. Mr. Ferris, of Utica, followed along in the same line, emphasizing the necessity of having properly written contracts in all such cases.

The president then called upon Mr. E. B. Fisher, of Grand Rapids, Mich., to address the meeting. Mr. Fisher spoke, in part, as follows: "Notwithstanding that the Michigan State Telephone Company (that being the designation of the Bell in that State) has recently been reorganized and rejuvenated, the independent movement in the State of Michigan is in a very comfortable and satisfactory condition. The independent properties of the State, without exception, are prosperous. Some of them are growing even more rapidly than is convenient or comfortable for them, more rapidly than the stockholders and investors in them provide the money. In our State we have recently done one thing that I think perhaps is worthy of consideration in other localities. We have formed what we know as the Michigan Traffic Association between the operating exchanges and toll companies in the State, to provide for a traffic committee of seven, and in the hands of that traffic committee is put the toll rate where a county is covered by two or more systems of lines, and this committee is a clearing house where settlements may be provided for. It provides for interchange of business and regulation of business, and also takes care to some extent of the question of permanency of toll line connections. It is an alliance, offensive and defensive, and when the articles of incorporation of that Traffic Association are duly signed by the companies in the independent telephone business in our State, it will be well-nigh impossible for any company to break away from its allegiance to the independent movement and take its service out of the inpendent ranks, and make contract alliances with the Michigan State Telephone Company. * * * * * * We have put in the hands of the Traffic Committee the regulation, within certain lines, of toll rates and of the methods of interchanging business, the conditions of business, the regulation of switching points where several companies may be interested. We have been experimenting on this subject for some time. It is a matter that has been called to our attention very forcibly. * * * * * * I think pretty much every independent company in Michigan is paying regular dividends, and most of them are paying 8 per cent.—and they are earning them. There is no doubt about that. Most of our Michigan companies are organized without any other securities than the common stock. The ordinary dividend in our State on independent telephone stock is 2 or 2¼ per cent. quarterly. We have in the State about 50,000 independent telephones, and that notwithstanding the fact that Detroit and that part of the State was taken out of the independent ranks."

Mr. Fisher then went on to cite some instances of the remarkable growth and prosperity of independent companies in his locality. In Jackson, Mich., previous to competition, the Bell had less than 400 telephones, and now the independent company has all of 2,200 telephones there, a city of 25,000 population. In Lansing, the capital, previous to competition, the Bell had 256 telephones, and to-day the independent company has over 1,800 telephones in that city and is getting orders at the rate of from fifteen to twenty-five a week right along. Mr. Fisher referred to other instances showing the great prosperity of the independent telephone companies throughout the West.

Mr. Taylor, of Penn Yan, was called upon to relate his experiences. "Penn Yan," he said, "is the county seat of the smallest county in the State of New York and has a population of a little over 4,000, and to-day we have over 700 telephones connected up in Penn Yan, which I think is the best showing, according to population, of any place in New York State, and perhaps in the United States. I want to tell you something about our blackboard system. I conceived the idea that it would be an advantage to our rural subscribers to have some means of communicating to each other and to the people in the town the fact that they had stock and produce for sale, or exchange, and so I put up a blackboard in one of the stores in Penn Yan, having connection by telephone with our head office. Now any subscriber who has anything to sell, or anything he wants to buy, can telephone it in to us and it is put upon that blackboard. People come in there to look it over and see if there is anything there that they want to buy or sell, and subscribers can call us up and we

inform them if what they ask for is on the blackboard. We get a room free of rent from one of the stores, for the sake of the advertising and the people it brings in there. It is also of great assistance in the way of procuring help. Help is pretty scarce in our locality, and any man who wants a job has only got to go to our blackboard and he is almost sure to find something there for him. Our subscribers have found this system a great convenience, and it has served to render our company more popular with its patrons."

The meeting then adjourned to give the delegates an opportunity to inspect the new exchange of the Frontier Telephone Company, representing, as it does, the very latest developments of modern telephony. The members and their friends were received at the Frontier Building by officers of the company and conducted through the various departments, and spent an interesting hour there.

In the evening a complimentary banquet at the Ellicott Club was tendered to the visitors by the Inter-Ocean and Frontier Companies. There were about 200 delegates and guests present. The decorations had a novel and appropriate feature, consisting of a desk telephone in the center of each table, connected with red and green-covered wires festooned to four central points in the ceiling, and thence to the toastmaster's place at the head table. The dinner was served in the club's very best style, and was thoroughly enjoyed by all. At the speakers' table B. G. Hubbell, of Buffalo, filled the rôle of toastmaster most acceptably. Speeches were made by James S. Brailey, E. B. Fisher, W. L. Cary, H. D. Critchfield, Frank H. Mott, J. G. Splane and A. L. Tetu, all of whom gave glowing accounts of the inauguration, growth and prospects of the independent telephone companies and movements in various sections of the country.

On Friday morning, June 24, the first thing on the programme was an inspection of manufacturers' exhibits, of which there were many handsome and attractive ones, mostly in rooms on the same floor as the convention room, and which were visited to a greater or less extent all the time during which the convention lasted.

At 10 o'clock the president called the meeting to order. The Executive Committee reported several proposed amendments to the by-laws. The most important of the proposed changes and one that caused considerable debate, was whether or not the Association should be composed of official representatives of independent telephone companies, one for each company, or of individual members. It was finally decided that all employees of independent telephone companies be admitted as associate members, with the right to vote on all questions. They are, however, to be denied the right to hold elective offices. The active members are to consist of representatives from each independent telephone company in the State.

The next business was the election of officers and the following were elected: President, Henry H. Persons, Buffalo, president of the Frontier Telephone Company, of Buffalo; first vice-president, Howard Hendrickson, of Albany; second vice-president, Boyd McDowell, Elmira; treasurer, T. Harvey Ferris, Utica; secretary, T. S. Lane, Buffalo. Executive Committee—George R. Fuller, Rochester; Henry H. Persons, Buffalo; Edward Davis, Philadelphia, Pa.; C. H. Poole, Utica; C. B. Rosser, Elyria, Ohio; James S. Brailey, Jr., Toledo, Ohio; J. S. C. Edwards, Johnstown; T. B. Basselin, Groghan; F. M. Potter, Syracuse; J. F. Stockwell, Oswego.

President George R. Fuller, the retiring president, then addressed the members present, thanking them and others for their loyal and hearty support during his administration and voicing the appreciation of the Association for the royal entertainment received at the hands of the Inter-Ocean and Frontier Companies while in Buffalo, and a rising vote of thanks was adopted and tendered to those companies for their kindness and hospitality.

As the newly-elected president, Mr. Henry H. Persons, was prevented by illness from being present, the chair was taken by First Vice-President Hendrickson. The usual votes of thanks to the retiring officers were then put to the meeting and unanimously adopted.

After some further miscellaneous discussion, it was decided to dispense with the afternoon session and the papers that were to have been read at that session will be printed in pamphlet form and distributed to every member of the Association. This was done so that the delegates could visit Niagara Falls. The titles of the papers and authors are as follows: "Telephone Construction and Its Proper Care," W. H. Johnston, Buffalo, N. Y.; "Methods of Exchange Operating and Its Relation to the Public," F. M. Potter, Syracuse, N. Y.; "Methods of Handling Toll Business," T. S. Lane, Buffalo, N. Y.; "Methods of Exchange Accounting," George R. Fuller, Rochester; "Telephone Conditions in Great Britain and Continental Europe," M. S. Conner, Rochester.

The question of the place for holding the next convention will be decided by the Executive Committee. The meeting then adjourned.

Development in Telegraphy.

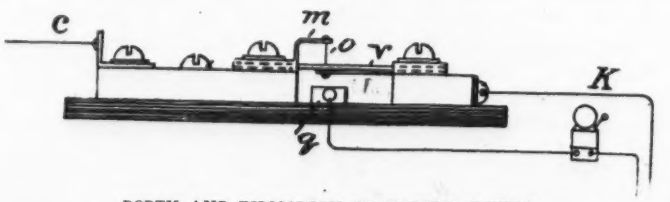
At the recent meeting in Indianapolis of the Association of Railway Superintendents were read two papers on widely different subjects, but based on the same fundamental fact, namely, that the telegraph stands unique among all other branches of electrical application in being comparatively stagnant in its development. Mr. L. S. Wells, in his paper on "The Typewriting Telegraph," refers to two recently developed typewriting telegraph machines as being in the line of improvement. After referring to the rapidity of development in other branches of electrical science, and to the multiplexing of telegraph circuits and the simultaneous use of wires for Morse and telephonic transmission, he continues: "However great and wonderful has been this advance scientifically, we are disappointed when we see the ancient Morse signals still the prevailing method of transmitting intelligence. The operator to-day bends in the same attitude over his key as did the early student of Morse, more than 60 years ago. If the Wizard of Jersey should recur to the art of his early choice he would experience very little difference in the method of making and deciphering dots and dashes from that of his younger days. Compared with other branches of electrical science there has been little progress shown, and it is a question whether the operator of to-day is more skilled than the pioneer of nearly half a century ago."

This same underlying thought is seen in the paper of Mr. J. B. Taltavall on "The Telegraph Operator in the Railroad Service," the first sentences of which read: "The lack of a trained understanding in the more important details of his profession on the part of the average telegraph operator is too often a serious drawback to his true usefulness. A student life in its broadest sense is requisite for the full intellectual development of the telegrapher in his profession." Here we have at once one of the causes for the lethargic condition into which things telegraphic have, until recently, lapsed, and one of the means of the uplifting of the art, i. e., education. In furtherance of his idea, Mr. Taltavall advocates the employment by railroad companies of instructors whose duties it shall be to teach operators holding positions which require some degree of technical knowledge for the proper performance of duties involved. "All railroads," he says, "have in their employ many persons abundantly able to fill the position of such an instructor, and the exercise of such a supervision would work decidedly beneficial results."

New Telephone Patents.

FUSE ALARM.

One of the advantages of the common battery system from a maintenance standpoint is the fact that the circuits may be largely arranged to be what may be called "self-testing." An example of this is the steady lighting of a subscriber's line lamp when any accidental cross occurs upon his line. Other troubles are indicated by the continuous fluttering of relay armatures and still others at once show themselves to the operator as soon as an attempt is made to use the faulty circuit. Similarly, fuses of the common battery system sometimes indicate almost at once when they have operated to cut off the current supply of their dependent circuits, while on the other hand another class of fuses give normally no indication of their operation until some subscriber complains. This latter class, to obviate this



RORTY AND THOMPSON PROTECTIVE DEVICE.

difficulty, must be provided with some sort of indicator. Such an indicator device is the subject of a patent granted to Messrs. M. C. Rorty and Geo. K. Thompson, jointly. In the figure is shown a sectional view of a fuse panel equipped with their device. Here *Kc* is the circuit to be protected, *o* being the fusible link, which it will be noted serves as a tension member between the springs, *m* and *v*. If the fuse operates, the closing of the electric alarm bell circuit through the bus, *q*, is at once apparent. The patent for this device has been granted to the American Telephone & Telegraph Company.

NEW TRANSMITTER ARM.

A rather novel idea in transmitter arms is comprised in a device invented and patented by H. J. Guttman, of Chicago. This is one of that type of pivoted arm such as is used to support the transmitters of wall sets. The transmitter casing is made integral with the arm itself, this latter being hollow; and as the base plate is also hollow a continuous enclosed channel is provided for the transmitter cord.

STEP-BY-STEP SELECTOR.

A step-by-step selective party line apparatus serves as a basis for a patent granted to W. M. James, of New Brighton, Minn. This apparatus has the usual features of a polarized ratchet and pawl motor actuating to rotate a selective wheel and thereby connect to the line station after station in succession. After conversation is completed a reversely poled impulse restores the apparatus. A novelty, none too commendable, is the introduction of a mercury contact through which the key connection at each station is made.

SPECIAL RINGING CIRCUIT.

A special arrangement of ringing circuits, suitable for a particular type of central battery switchboard patented some years ago, has been patented by C. E. Scribner and assigned by him to the Western Electric Company. In the switchboard in question each line is normally shunted for ringing currents in a manner to cause the bells to fail. This difficulty has been overcome by introducing a ringing transformer with the secondary in series in the shunting circuit and the primary under control of the ringing key.

Technical Education and Gas Engineering.

In a paper read before the Gas Congress, recently held in St. Louis, Mr. Henry L. Doherty points out forcibly the desirability of the gas industry recognizing in a greater degree the advantages of technical education.

It is to be regretted, he said, that a gas engineer has practically no recognized standing amongst professional men. The knowledge and training necessary to make a man an electrical engineer are fairly well defined. The same is true of our mechanical engineers and even of our chemical engineers. It is doubtful whether any two men in the audience would give the same answer to the question, "What constitutes a gas engineer?" Sometime or other the members of the gas fraternity must speak through their associations and say what does constitute a gas engineer, and it is, therefore, an opportune question whether gas engineering shall be confined to the narrow limit of coal and water gas, or whether it shall be a broad term, such as electrical engineering wherein the telephone, telegraph, high-tension and storage battery engineers all assemble under one banner.

The suggestion has been made that some college be induced to give a degree of gas engineering, but this does not appear to be the proper starting point. We should first determine what constitutes a gas engineer and how he should be trained, and only then would the degree of gas engineering have any real meaning. As the matter stands to-day many are devoting their lives, or at least the best years of their lives, to a branch of engineering work which is not recognized by other professional engineers. This brings up the problem of proper education.

It is probably not the wish of anybody that the men lacking in technical training should be eliminated from the gas business. These men, with their valuable practical experience and by association with technically-trained men, can make themselves extremely valuable. They are the kind of men who can never be entirely eliminated, and there is no desire to do so; but the gas business already possesses a preponderance of this class of men, and it seems desirable that the new recruits should come to the gas business thoroughly educated and possessing all the necessary fundamental knowledge to enable them to take up the special problems of the gas business. This means a college-educated man, and educated for the purpose of entering the gas business, but until some course in gas engineering is provided it probably means a well-educated mechanical engineer with special training in chemistry, thermochemistry, heat, combustion, thermodynamics, physics and economics.

It is not hard to find men in the gas business who have an outspoken contempt for a college education. This is due, in a large measure, to a misunderstanding of the difference between a classical and an engineering education. Some of the graduates from classical schools who have entered upon ordinary business work, financiering, pawnbroking, or other like professions, have brought the whole college fraternity into disrepute. There are some classes of work where a classical college education is at least of very doubtful value, and to the writer's mind is an absolute disadvantage.

The American people measure success by a man's money-getting powers, and the average money-getter has little or no need for education. These men contribute their share toward the world's progress, but they are an element that could be sacrificed with less retardation to progress than could other elements which the public forgets and whose leaders are probably unknown to the general public. It is the engineer, the scientist and the inventor who have made this world pleasant to live in, and these men are now gradually receiving recognition. For this and other reasons, engineering is becoming a more popular branch of study and a more respected profession.

It is absurd to suppose that you can take four years of a man's life for special education and not be able to better educate him than to rely upon the information he may pick up by chance in some occupation providing for daily routine. If such is not the case, it simply means that our present methods of education are all wrong, and perhaps the responsibility for this condition rests on the men like ourselves. If a college education spoils a man, it should be so changed that it will benefit him, and if we are the men who take it upon ourselves to insist that a college education does spoil him, it is at least in a measure incumbent upon us to indicate how this college work should be changed to make this man useful to us.

Statistics on the progress of college-educated men will surprise many people that now ridicule the value of college education. The last United States Census shows that 2.2 per cent. of males over 30 years of age have had a college education. Taking the publication "Who's Who in America," of the 10,704 men represented, 72.02 per cent. were college trained. We thus have the very remarkable showing that while the college-trained man represents only 2.2 per cent. of the male population over 30 years old, yet 72.02 per cent. of the notables come from this 2.2 per cent. of the population.

Electrical Engineering at Purdue University.

For the college year just ended the total enrollment at Purdue University was 1,440. The total in the electrical engineering department was 418, distributed as follows: Seniors, 58; Juniors, 90; Sophomores, 125; Freshmen, 145.

The thirtieth annual commencement of the university was held on Wednesday, June 8, the graduating class numbering 187. Advanced degrees were conferred on twelve candidates, and the degree of Doctor of Engineering upon Elwood Mead, Class of 1882, chief of the Bureau of Irrigation, United States Department of Agriculture.

Of the graduates in electrical engineering, Messrs. F. H. Miller, F. Riebel, Jr., Hartley Rowe, F. H. Nealis, H. Berthold, R. H. Davidson and L. J. Kirby have entered the employ of the Westinghouse Electric & Manufacturing Company; J. G. Anthony, the Bullock Company; L. D. Waldron, the Commercial Electric Company; R. G. Mansfield and M. E. Weidner, the Stanley Electric Company; George D. Babcock, Syracuse University; F. C. Watson, Norfolk & Western Railway Company, Roanoke, Va.; J. M. Reynolds, Western Electric Company, New York; J. R. Whitehead and Frank Loring, the Stromburg-Carlson Company, Rochester, N. Y.; J. R. Gregory, W. J. Drury and C. E. Layton, the Western Electric Company, Chicago; Clyde Keirn, the Chicago Edison Company, Chicago; R. M. Harris, Electrical Department, Purdue Uni-

versity; C. C. Bradbury, Underwriters' Laboratory, Chicago; W. M. Hinesley, Dayton (Ohio) Railway Company; W. C. Martin, Arnold Electric & Power Station Company, Chicago; H. E. Smiley, Chesapeake & Ohio Telephone Company, Baltimore, Md.; A. P. Wood, Fort Wayne Electric Works, Fort Wayne, Ind.; C. E. Kailer, Indianapolis & Northwestern Traction Company, Lebanon, Ind., and H. H. Arnold, Indianapolis Light & Power Company, Indianapolis, Ind.

CURRENT NEWS AND NOTES.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—The next meeting of the Association of Edison Illuminating Companies will be held at Hotel Wentworth, New Castle, N. H., August 30 and 31 and September 1, 1904. Mr. W. S. Barstow, of Portland, Ore., is secretary, and Wilson S. Howell, of New York, assistant secretary. Mr. Howell's address is Eightieth Street and East End Avenue.

MOTHS STOP TROLLEY MOTORS.—An item from Philadelphia states that on June 27 moth millers by the hundreds of thousands descended upon the northeast part of the city, put out arc lights and stopped trolley cars. Kensington looked as though it were in a snowstorm. Where the clouds of moths came from is a mystery. They disappeared as rapidly as they came. It was around the arc lights that the moths centered, and heaps of them, falling on the tracks, stopped the trolleys.

BRITISH WORLD CABLES.—A special dispatch of June 27 from Vancouver, B. C., says: "The Canadian Board of Trade of Ottawa has asked every board of trade in the British Empire to join it in urging the Imperial Government to secure control of all cables in British possessions and construct new cables from Australia and from the Cape to England. One of the many reasons given in favor of such a step is that no foreign country could use the lines for its own benefit in case of war. The proposition was received with enthusiasm here."

SINGLE-PHASE MOTOR DESIGN.—In a British patent recently issued to G. Finzi and E. Korrodi, of Milan, Italy, is described the method for obtaining efficient commutation and high power factor with alternating-current motors, which is associated with the name of the first-mentioned engineer. This consists in so constructing the magnet frame that the pole surface opposite to the armature is decreased in cross-section by tapering toward the armature, the object being to reduce the e.m.f. of self-induction of the armature to a minimum and to decrease the cross magnetizing effect of the armature current.

EXPOSITION ELECTRICITY CLUB.—An organization embracing all electricians connected with the St. Louis Exposition was formed last week. It is known as the Exposition Electricity Club, and is of a social and technical nature. The following officers were elected: President, Frank H. Gale, of Schenectady, N. Y.; first vice-president, W. K. Dunlap, of Pittsburg, Pa.; second vice-president and chairman of Entertainment Committee, H. W. Pope, of Boston, Mass.; third vice-president and chairman of Membership Committee, J. W. Dunfield, of Cincinnati, Ohio; treasurer, F. V. L. Turner, of Chicago. These officers and the following-named members constitute the Executive Committee: W. A. Layman, St. Louis; Edward Dixon, technical assistant, British electrical section; Cloyd Marshall, Department of Electrical Exhibits; C. B. Fairchild and O. A. Mygatt.

CANADIAN ELECTRIC RAILWAY AND TELEPHONE STATISTICS.—From a paper read at the recent convention of the Canadian Electrical Association we gather the following facts: The 46 Canadian railways sending returns operate 455 miles of single track and 193 miles of double track, using 2,053 motor cars. The equipment represents a paid-up capital of $29,838,326 and bonded debts of $17,013,758, the gross earnings being $7,777,324 and gross expenses $5,018,799. The expenses form 64.5 per cent. of the earnings. The earnings were approximately 4.6 cents per passenger carried and the expense appears as 12.6 cents per car mile. On the basis of the population of the last census, there is in Canada one telephone instrument to every 65 persons. In British Columbia the ratio is one telephone to every 33 persons, while in the Northwest Territories the figures are one to 251.

TUNING ELECTRIC CIRCUITS.—An interesting line of work in the development of commercial wireless telegraphy is disclosed in a patent issued June 21, 1904, to Ferdinand Braun. The maximum of effect at both the sending and the receiving station is produced only when the circuits are tuned, so that each circuit, due to its component parts and their electrical distribution, possesses the same fundamental period of oscillation. The lack of symmetry due to the sending or receiving wire is counteracted by the addition of straight wires, coils or condensers, such added circuits being adjustable in value when desired, as with ships and balloons. The diagrams illustrate closed oscillating circuits containing condensers in two parts, for purpose of ease of adjustment, and a shunt circuit containing a coherer directly connected to the receiving wire. According to another method of operation the coherer is located in a secondary circuit of which the primary is shunted to the condensers.

GOVERNMENT WIRELESS SERVICE ALONG COAST.—A Washington dispatch states that the Secretary of Agriculture has directed Chief Moore, of the United States Weather Bureau, to take immediate steps to add wireless telegraphy to the present equipment of all vessel-reporting stations, so that in addition to reporting all vessels passing within range of the stations the craft farther out at sea may be reported. The tests made by the Weather Bureau show that with only such a transmitting power as vessels conveniently can carry it will be possible easily to keep them in communication within a range of two hundred miles off shore. This extension of the system affects both the Atlantic and Pacific coasts and the Gulf line. The service is to be performed at Nantucket, Block Island, Cape Henry, Cape Hatteras, Jupiter, Fla.; Key West, Port Eads, Galveston, San Diego, Farrallon Islands, off the Golden Gate, North Head, at the mouth of the Columbia River, Tatoosh Island, at the entrance of the Straits of Juan de Fuca, and Port Angeles, about sixty miles in from that entrance.

WIRELESS FOR CENTRAL AMERICA.—As the result of tests conducted under the direction of Lieut.-Commander Jayne to determine a system suited to meet the requirements of the navy in communication between Key West and Panama and intermediate points possessed by the United States, a contract has been signed between Rear Admiral Manney, chief of the Naval Bureau of Equipment, and Abraham White, president of the American De Forest Wireless Telegraph Company, by which the navy will acquire five wireless circuits, two of them of more than 1,000 miles in length. The arrangement grew primarily from the necessity of protecting the Panama Canal by securing a secondary means of communication and was emphasized by the lesson learned from the isolation of Port Arthur in the war between Russia and Japan. The service which the De Forest company guarantees to establish is remarkable in that messages must not only traverse the ocean, but considerable parts of land in the West Indies. Under the contract the De Forest company guarantees to maintain reliable service on the following circuits: Key West to Panama, 1,000 miles; Porto Rico to Key West, 1,000 miles; Guantanamo, on the south Cuban coast, to Panama, 720 miles; Pensacola to Key West, 450 miles; Guantanamo, on the south Cuban coast, to Porto Rico, 600 miles. Under the agreement the Navy Department will operate in harmony with such stations and vessels as now use the De Forest system, its instruments will be attuned to harmonize with those of the De Forest company, and it will use the company's key of vibrations.

MEASURING THE WAVE LENGTHS OF OSCILLATIONS.—A patent granted June 21, 1904, to Johannes Dönitz relates to an apparatus by means of which may be read from a properly graduated scale the wave length of the oscillations in the electric circuit. The principle of the instrument rests upon the resonance effect produced when in a given circuit the capacity and self-induction

bear a proper relation corresponding to the frequency of the circuit. Having the one fixed in value and the other adjustable at will by suitable mechanism, a balance between the two can be obtained throughout the range of the instrument. A graduated and calibrated scale over which plays a pointer connected to the adjusting mechanism, serves to indicate the frequency at which a balance is formed and, from the rate of travel of electrical disturbance, the wave length corresponding to the frequency is immediately determinable, or the calibrated scale can be graduated to read in length of wave directly. The condition of balance determined by the circuit frequency is detected by a current indicator in the form of a wire enclosed within an air space, and arranged to be heated by the current which passes through it under conditions of resonance of the connecting circuits. The expansion of the heated air forces a column of liquid up an indicating tube, and a sudden movement of this column as the instrument is varied in adjustment serves to denote the condition of most perfect balance.

LIGHTNING RODS.—Prof. W. S. Franklin, of Lehigh University, in a report to the United States Weather Bureau, lays down certain considerations applying to the selection and installation of lightning rods. The principle of these are that lightning rods should have a good ground and as straight a course as possible, be in the form of a wide band, a thin walled tube or a wire cable, rather than that of a solid wire.

FATHER OF THE TELEGRAPH.—The old, old controversy as to the relative credit of Morse and Vail in the invention of the electromagnetic telegraph has again been reopened in a correspondence recently appearing in the New York *Times*, Mr. Stephen Vail and Mr. Edward Lind Morse being the controvertialists. Nothing new is added to the subject, which has been so thoroughly gone over during the past half century that at this date only the addition of new evidence would justify its reconsideration.

PRINTING TELEGRAPHS.—An article in *Electricity*, of London, says: "It is understood that the Murray typeprinting telegraph has now been adopted by the British telegraph authorities, from which it may be inferred that a formidable barrier of prejudice has been broken down by the technical officers, assisted probably by Mr. Trenam, the controller, whose well-known progressive spirit has once more asserted itself. The knowledge that this system has found favor in the eyes of those best qualified to judge upon its merits, must be galling information to some of the little nobodies who were boastfully waiting the opportunity to condemn it with one fell swoop of the pen. That their opinion was never solicited is only what anyone with the slightest perspicuity might have foreseen all along. To endanger the prosperity of a scientific department by heeding the inane platitudes of such dogmatic incapables would, indeed, be a false mistake."

GOVERNMENT WIRELESS TELEGRAPHY.—A special dispatch from Washington of June 25 says: "President Roosevelt today appointed Rear Admiral Robley D. Evans, Rear Admiral Henry N. Manney, Brigadier-General A. W. Greely, Lieutenant-Commander Joseph L. Jayne and Prof. Willis L. Moore, Chief of the Weather Bureau, a board to consider the question of wireless telegraphy in the service of the government. To quiet a spirit of competition which has sprung up between three departments of the government, each desiring to control the operation of wireless telegraphic plants on the coasts, the Cabinet decided that the whole subject should be referred to a board composed of representatives of the War Department, the Navy Department and the Department of Agriculture. This board, which was appointed to-day, is expected to make a thorough inquiry into the merits of the various systems of wireless telegraphy now in use, with a view to selecting some apparatus that will work interchangeably with any and all of the best systems now installed on shipboard. It also will determine which of the executive departments shall take charge of the shore installations and prescribe the extent to and the terms on which the governmental system shall be applied to the commercial marine."

PERMEABILITY OF CAST STEEL.—In a paper before the American Society for Testing Steels, Mr. H. E. Diller, discussing the effect of the composition of dynamo steel upon its permeability, states that the general rule among foundries making steel castings for electrical machines is to attempt to obtain approximately the following composition: Silicon, .10; sulphur, below .07; phosphorous, below .07; manganese, below .05, and carbon, below .10. The tests upon bars, which varied in composition from the above specifications in only one element, showed that carbon and manganese, as might be supposed, have a very harmful effect on the permeability, but 43 per cent. of manganese lowered B of the annealed steel only 1 per cent. This seems rather strange in view of the strong effect manganese has in lowering the permeability of cast iron. The addition of phosphorous, silicon and aluminum increases the permeability slightly at low density and decreases it at high density. The tests would indicate that a substantial increase in permeability cannot be gained by additions of silicon or aluminum unless they are added to the extent of several per cent., and it is doubtful if any increase can be obtained at high densities. Considerably more than 2 per cent. of phosphorous would be required to effect the permeability to a marked degree. It seems safe to remove the upper limits for these three elements in specifications for cast steel for dynamo work, so far as concerns their effect on the permeability.

LETTERS TO THE EDITORS.

Alternating-Current Wave Form Analysis.

To the Editors of Electrical World and Engineer:

SIRS:—In the issue of ELECTRICAL WORLD AND ENGINEER of May 28, 1904, there appeared an article by Mr. S. M. Kintner on "Alternating-Current Wave Form Analysis," in which was given a series of tables for the determination of the constants entering into Fourier's equation for a distorted wave. These constants as tabulated in the paper are simply the sines and cosines of the multiples of five degrees, and the method as a whole does not materially differ from that described in the appendix to Prof. D. C. Jackson's well-known text-book on "Alternating Currents and Alternating-Current Machinery." The undersigned, however, wishes to direct the attention of those interested in this subject to a paper which he published in March, 1901, in the *Physical Review* (Vol. XII, page 184) on a "Graphical Method for Analyzing Distorted Alternating-Current Waves," in which a method is described which eliminates entirely the use of tables of any kind. The graphical construction involves only the use of circles and straight lines, and the quantities whose summation give the desired constants of the equation may be put down directly from a single figure. An example worked out in the course of the paper shows that the method is quite accurate. It is based on Fourier's series.

ST. LOUIS, MO. ALEXANDER S. LANGSDORF.

Röntgen Ray Tube.

To the Editors of Electrical World and Engineer:

SIRS:—I notice in your issue of June 18, under "Current News and Notes," a statement that Dr. J. Mount Bleyer has announced that he has discovered a new kind of Röntgen ray tube. As a matter of fact, I made this discovery some three months ago, and on meeting Dr. Bleyer at the New York College at Twenty-third Street, asked him to come to my laboratory at 156 East Twenty-third Street to see this new tube. I do not claim anything special in connection with this tube other than that it fluoresces blue, and does not absorb or cut off so much of the Röntgen rays as flint glass is likely to do.

NEW YORK. GEO. J. MONAHAN.

Effects of Induction on Railway Motors.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the article appearing in your issue of May 21, 1904, page 980, by Mr. E. H. Anderson, on the effects of self-induction on railway motor commutation. The writer had a somewhat similar experience with a 200-kw rotary converter installed at the Butte sub-station of the Missouri River Power Company. This rotary gives about 16 to 17 volts per bar and the brushes were subject to glowing and flashing over at any slight

change of load. The commutator had been turned down three times in ten months and the machine was making a very bad record for itself. The writer suggested to the foreman of this station to cut a narrow slit in the carbon brushes with a hack saw blade parallel to the mica in the commutator, about ¼ of an inch in depth. This was done and immediately the commutator started to gloss up and polish. The brushes have not been changed for the past six weeks, while it had been the usual practice to change brushes every three or four days and to boil them in vaseline.

It will be noticed that this method of overcoming this trouble reduces the carbon contact surface very little. The machine is now operating very satisfactory, carrying at times 50 per cent. overload without any trouble.

BUTTE, MONT. FRED. P. DE WILDE.

Storage-Battery Plate Construction.

To the Editors of Electrical World and Engineer:

SIRS:—Allow me to correct a misprint in my article which appeared in your issue of June 18. On page 1160, paragraph 8, line 18, first column, it reads: "The argument is advanced that the grooves should be tightly filled in order to maintain contact between the grid and the active mass."

It is not this statement that I condemn, but in the same paragraph of the article Mr. Donaldson goes on to say that an additional active mass *could not* be formed in a Planté positive if the grooves are *tightly filled*. It is to this point that I wished to take exception.

BUFFALO, N. Y. G. H. RABENALT.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Noise from Machines.—FISCHER-HINNEN.—An article on the noise made by some modern machines, which might be called shrieking or whistling. It occurs especially with machines with laminated poles, a small air-gap (1.5 to 3 mm.), and a small number of slots. The pitch of the whistling note depends directly on the number of teeth, while the amplitude of the sound decreases with the increasing number of slots. With 13 to 15 slots per polar arc the noise is very small and disappears entirely for a greater number of slots. In modern machines, however, the number of slots is much smaller, for instance 6 to 9 per polar arc. Even with only 5 slots it is possible to produce machines which do not shriek if a certain condition given below is fulfilled. As to the cause of the noise, it can be shown that it depends directly on the number of slots of the armature, while the real seat of the sound is to be found not in the armature itself, but in the poles which begin to vibrate under the influence of the magnetic field varying for the different positions of the armature. The number of vibrations can be easily determined by means of a tuning fork. The rule giving the condition under which there should be no noise is that

$$\frac{b - 0.7\,r}{(D + 2\delta)\,\pi} N_1$$

must equal a whole number plus 0.5. In this equation N_1 is the number of slots, while the meaning of the other letters may be easily seen from Fig. 1. D is the armature diameter and r is the

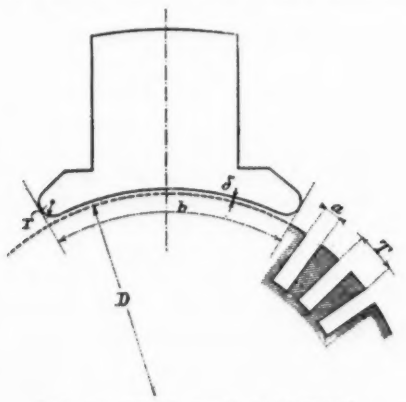


FIG. 1.—NOISE FROM MACHINES.

radius of the circle representing the curvature of the pole shoe at their ends. If the shoes have no round corners, but sharp corners, b is to be substituted for $b - 0.7\,r$ in the above formula. He has tested this rule for 25 machines and has found it to be correct as long as the number of slots is relatively small. If it is very high, no whistling noise is heard even if the above condition is not fulfilled.—*Zeit. f. Elek.* (Vienna), June 5.

REFERENCE.

Design of Generators.—PARSHALL AND HOBART.—A communication giving some notes on what they consider to be thoroughly up-to-date generators in their design. They have formerly arrived at the result that in practice the core loss in watts per kg. could be derived directly from the product of frequency and core density. This view has been fully confirmed by the investigations of Esterline and Reid.—Lond. *Elec.*, June 3.

POWER.

A Revolution in Prime-Movers.—BELL.—An article on the uncertainty of the prime-mover for central station work. At the present time steam turbines of half a dozen different forms are being actively exploited, representing various modifications of the turbine idea and varying in construction over even a wider range than do water turbines, but in much the same sort of way. They possess in common the characteristic of very high rotative speed, which is the source of their strength and of their weakness. It results in a very large output of power from a relatively small machine of moderate cost and great compactness, and in extraordinarily low friction losses, especially in the vertical shaft type. The mechanical efficiency is high at all loads and relatively very high at low loads. On the other hand the high speed means greater precautions in both workmanship and material in order to insure safety, and makes the turbine inconvenient for direct coupling to direct-current machinery. Hence, turbines are at least temporarily barred from the very field in which their good qualities would be of the greatest value; that is, in small central station railway plants or isolated lighting plants. The future of the turbine is, therefore, linked with the future of alternating current. As to the actual relative efficiencies of turbines and engines in steam required per kw-hour of output, the figures thus far obtained leave the issue in doubt. Worked at the same initial steam pressure, degree of superheat and vacuum, the compound engine seems to hold its own well at full load with the turbine, although the conditions are so seldom the same that comparisons are far from easy. At present the two machines are neck and neck, but both have to reckon with a very serious competitor in the internal combustion gas engine. This prime-mover starts with the advantage of a thermodynamic efficiency far in excess of anything which there is yet reason to expect from steam engines of any sort. The gas engine will shortly force its way into central station practice as a standard apparatus, and from that point on it is anybody's race in the struggle for supremacy, with certain intrinsic advantages in favor of the gas engine.—*Am. Elec.*, June.

Mining Locomotives.—WARREN.—An illustrated description of the use of electric chamber locomotives in the Delaware, Lackawanna & Western coal mining department. As this company has a large number of mines equipped with electric power on many of the gangway roads, the next step was to handle the cars from the branch to the chambers and return. Having the electric power, the best method was to handle the cars with electric locomotives, if this could be done without the use of a trolley wire in the chambers. A trolley wire is objectionable since it would be necessary to constantly increase the length of the wire in the chambers as the work progresses: and furthermore, the locomotive could not work close to the face on account of the blasting, which would blow down the trolley wire

if it were run in too far. Locomotives with a cable reel device were then installed and have proven quite satisfactory.—*Mines & Minerals,* June.

Superheated Steam and Reheating.—MARKS.—A résume of tests made on nine vertical, high-speed, two-cylinder, cross-compound, direct-connected units with overhanging crank, and varying in capacity from 750 to 2,500 hp, to determine the performance of the engines under different loads, both with and without jacketing and reheating. The principal results of the tests are summarized in a table. The conclusions of the author are as follows: Jacketing high-pressure cylinders is of little value when moderately superheated steam (100° F.) is used; reheating is probably a source of loss unless it superheats the receiver steam at least 30° F. and is not fully effective unless it superheats about 100° F., when it may effect a saving of 6 to 8 per cent. of the total heat used per indicated hp; jacketing the low-pressure cylinder appears undesirable when the reheating is effective; the variation within the ordinary limits of ratio of stroke to diameter in large-sized engines of the same power when using moderately heated steam does not have any marked effect upon the economy of the engine.—*St. R'y Jour.,* June 11.

REFERENCES.

Engine Room Management.—EDWARDS.—An illustrated article of a very practical nature giving specific instructions for the proper performance of those duties which naturally devolve upon an operating engineer.—*Am. Elec.,* June.

Crane.—The first part of an illustrated description of a 150-ton crane for docks.—*Elek. Anz.,* June 5.

High-Speed, Motor-Driven Pump.—A description of a pump which has its plungers connected to cranks mounted directly upon the motor shaft. Its capacity is about 950 liters per minute against 300 meters head when running at 300 r.p.m. It is operated by a 100-hp shunt motor.—*St. R'y Jour.,* June 11.

TRACTION.

Current Supply to Electric Railways.—REICHEL.—An illustrated paper read before the Berlin Electrical Society and discussing mainly the methods of supplying large amounts of electrical energy to trains. A main-line train, intended to run at a speed of 150 to 200 km. and consisting of a motor car and four trailers of together 250 tons of weight, requires for the main starting period about 2,000 to 3,000 kw. If direct current should be used with 1,000 volts, this would mean 2,000 to 3,000 amp., and there would be difficulty in supplying such powerful currents to the motor car. With the three-phase system, much higher voltages can be used, so that the current is correspondingly reduced. He describes the different designs of an overhead construction and means for collecting the current from the overhead wire, which were used by the Siemens & Halske Company on various lines, and especially on the Marienfelde-Zossen line. Fig. 2 shows the latest construction. This is said to have given

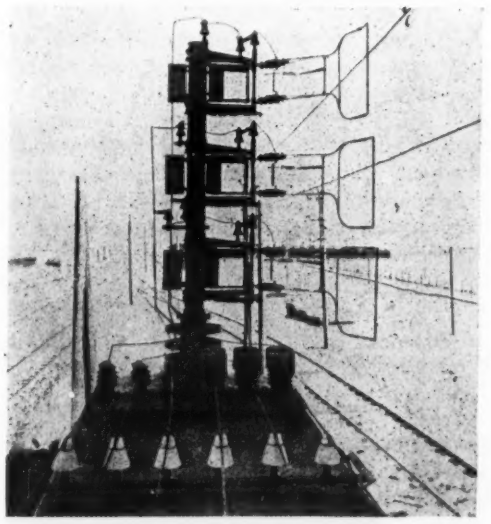


FIG. 2.—CURRENT COLLECTORS.

complete satisfaction, such quantities of energy as 2,500 kw at 15,000 volts being successfully taken off from the overhead wire. The contact between the bow and the overhead wire is excellent and the wear and tear, due to friction, is small. The bow is thought to be vastly superior to the trolley wheel. While the pressure of the bow against the wire is about 3 to 4 kg., the pressure of the trolley wheel is 20 to 25 kg. at 75 km. speed. At the higher speeds of interurban railways, the cost of maintenance with trolley wheel is for this reason higher than on ordinary street railways. The author believes that the bow construction will find general application for traction. In the second part of his paper he discusses the comparative advantages and disadvantages of the different systems suitable for suburban lines. The three-phase system would not be suitable on account of its complications in line construction, etc. For suburban lines the question is whether direct-current or single-phase alternating current is to be used; the author compares the following three systems: First, direct current at a voltage up to 1,000, with current supplied through a third rail, the running rails being used for the return current; high-tension, three-phase current transmitted to converter sub-stations, the motors on the car are wound for 1,000 volts; this system may also be used as three-wire system with the earth as neutral and the outers having a tension of 1,000 volts against earth, so that the tension against the outers is 2,000 volts. The second system is direct current at 2,000 or more, the current being supplied to an overhead wire, the running rails being used for the return circuit; two 1,000-volt motors are always in series in the car; the power plant supplies direct current at 2,000 volts with a two-wire system, and 4,000 volts with a three-wire system, the latter system being sufficient for more extended suburban roads; since larger direct-current motors can be built for 1,500 volts, a voltage of 6,000 may be selected with a three-wire system; an example of this system is the road from St. Georges to La Mure (Thury system). The third system uses single-phase alternating current at 6,000 volts or more, current supplied by a single overhead line and returned through the running rails. He discusses the various advantages and disadvantages of these three systems and gives some comparative tables of cost, especially of the first and third systems. He thinks that if everything is taken into consideration, neither the one nor the other is decidedly preferable on the whole over the other, although the simplicity of construction speaks in favor of the single-phase system. While the prospects for the latter are good in general, the author thinks that for certain roads—for instance, elevated and underground roads—one will continue to use the direct-current system. For long-distance main lines, he thinks that a three-phase system is not out of question.—*Elek. Zeit.,* June 9.

REFERENCES.

High-Speed Traction.—SIEMENS.—The first part of an illustrated paper read before the (British) Institute of Electrical Engineers, giving an historical summary of the high-speed electric railway experiments on the Marienfelde-Zossen line.—Lond. *Elec.,* June 10.

Interurban Line.—An article giving details of a projected double-track electric railway to be built between Boston and Providence. It is expected to cover the 45 miles between the cities in a little over two hours.—*St. R'y Jour.,* June 11.

Electric Traction in Italy.—LANINO.—An article discussing the prospects of the introduction of electric traction on various railroad lines in Italy. The author discusses the local conditions of that country.—*Elek. Zeit.,* May 26.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Helena.—An illustrated description of the sub-station at Helena, Mont., which supplies the city with electric light and power. The city depends entirely upon this sub-station, which is operated from the water power plant of the Missouri River Power Company over a long-distance transmission line. There is but one room in the station and this contains in the rear nine 11,000 to 2,200 or 363-volt step-down transformers, the three transformers, with 363-volt secondary supply current for two 175-kw rotaries, two 75-kw motor-generators and three Hartford tub transformers. The other six transformers are wound with 2,200-volt secondaries and supply the lighting current for the city. The lighting transformers are provided with 17 secondary taps and a potential regulator faceplate, giving a range of 400 volts regulation on the secondaries. The company is now operating 25,000 lamps of 16 cp, 250 arc lamps, 300 hp in motors and 17 street cars.—*Am. Elec.,* June.

REFERENCES.

Automatic Protective Devices.—ANDREWS.—The first part of an illustrated account of various automatic devices for electric circuits.

In the present installment he deals with the differential solenoid type of release, the motor or wattmeter type of release, the pendulum relay type of release, the direct-acting, reverse-current release types and the alternating-current discriminating devices.—Lond. *Elec. Rev.*, June 3.

High-Tension Switch.—An illustrated description of high-tension oil switches made by an English company.—Lond. *Elec.*, June 3.

Switches.—LINDENSTRUTH AND FORSTER.—An illustrated article on the control of electric switches from a distance.—*L'Eclairage Elec.*, June 11.

Cape Town.—A long illustrated description of the Cape Town municipal electricity plant in South Africa. The direct-current system is used. The power house contains one 150-kw, one 300-kw and two 750-kw generators.—Lond. *Elec.*, May 27, June 3.

Kettering.—An illustrated description of the new electric works of Kettering, which are operated in connection with a refuse destructor. The three-wire, direct-current system is used with a voltage of 2 × 250.—Lond. *Elec. Rev.*, June 3.

WIRES, WIRING AND CONDUITS.

Conduits and Condensation.—An article in which the author says that whenever condensation troubles occur they take place chiefly on the outside of the tubing when a change of temperature, sufficient to cause a precipitation of dew, has occurred between the surface of the conduit and the surrounding atmosphere. This condensed water trickles along the conduit, and succeeds eventually in getting into the joints to the interior and finally comes to rest in some suitable bend, to the detriment of the cables or wires. It tends to accumulate at such places, since the conditions for evaporation are poor in the extreme. If the conduit is lined with a non-conductor which has a store of heat to give off, the latter tends to wipe out periodic changes of temperature. It acts as a kind of jacket giving off its store of heat to the iron sheath. In damp situations this property may be very valuable, since during the working hours the insulating material will probably get heated some degrees above the atmospheric temperature of the surroundings. This will be given out slowly, tending to neutralize the cold, and consequent condensation, in the early mornings. Further, the lining prevents creeping of moisture along the internal surface of the tube from joints, etc., which is a matter of considerable importance where wiring of cellars, laundries, etc., has to be carried out. When conduits are embedded in dry mortar they are practically jacketed from all sudden thermal changes, and in this case the advantage of an insulated lining is discounted. Moreover, there cannot be much condensation going on during the working hours of an installation, and on the whole, while lined conduits are desirable in certain circumstances they are not necessary in the great majority of cases.—Lond. *Elec. Rev.*, June 3.

Plug and Socket Connectors for Testing Rooms.—EMERSON.—An illustrated description of the method adopted at the Pratt Institute in Brooklyn for connecting up apparatus in the laboratory. The terminals from the different parts of the apparatus are brought to brass sockets mounted on slate slabs, as are also those from the switchboard instruments or rheostats. Brass split plugs which make reliable contact in the sockets and fit firmly enough not to be easily displaced attached to flexible cables, are provided for connecting the sockets. The cables are of various lengths. Some have plugs on both ends and some have a plug on one end only and a short piece of No. 6 copper wire soldered to the other end, which will enter readily into the binding posts of measuring instruments and rheostats.—*Am. Elec.*, June.

REFERENCE.

Wiring of Exposed Steel Frame Buildings.—WEEKS.—A descriptive article with sketches and notes as to the ways in which wires are secured to steel beams and girders.—*Am. Elec.*, June.

ELECTRO-PHYSICS AND MAGNETISM.

Electrons.—LARMOR.—A paper "on the ascertained absence of effects of motion through the ether, in relation to the constitution of matter, and on the Fitz Gerald-Lorentz hypothesis." Concerning the hypothesis that electricity is atomic, he says that even if the nature of the particles of the cathode discharge had never been made out and the Zeeman effect had never been discovered, yet the facts known to Ampere and Faraday are sufficient to demonstrate that no other conception of electricity than the atomic one is logically self-consistent. The author concludes as follows: "As electrons are already held to be a reality on various grounds, theoretical and experimental, it would appear, therefore, that there is much to be said for a benevolent attitude to the proposition that all the interactions of matter, so far as the laws of physics and chemistry extend, are to be described as phenomena occurring in and through the ether, and thus differentiated from the more recondite world of vital growth and change which they make manifest to our senses. This principle does not yet, so far as one can see, stand in the way of any other branch of physical science, while it accounts for the very remarkable absence of influence of the earth's motion through space on the most sensitive phenomena, and is almost led up to thereby."—*Phil. Mag.*, June.

N-Rays.—BROCA gives some practical rules with regard to the N-ray examination of the human body. Broca and Zimmern give together the results of their investigation of the spinal marrow by means of N-rays. They identify certain nerve centers by this means with greater exactness in the living subject than had been possible by any other method. Becquerel has made experiments to determine how much of the increased luminosity and distinctness of a feebly luminous surface is due to the direct action of the N-rays upon the luminosity of the body, and how much is due to the action upon the eye of the observer. There is some objective increase in luminosity in the case of small flames at all events, as shown by photographic records, but he shows that in the case of a feebly luminous surface the action consists in the liberation of N-rays from the surface, and these N-rays proceed to the eye together with the light rays, and impart a greater sensitiveness to the retina.—*Comptes Rendus*, May 9 and 16; Lond. *Elec.*, June 3.

REFERENCES.

Alternating-Current Diagrams.—KARAPETOFF.—A continuation of his serial on amplications of alternating-current diagrams. He gives elementary examples of the connection of the resistances in parallel and the series-parallel connection of resistances, and gives the vector diagrams of the transformer.—*Elec. Club Jour.*, May and June.

Electrical Vibrations.—POLLOCK.—An account of an experimental investigation made to compare the periods of the electrical vibrations connected with narrow, rectangular, closed circuits, with those of the oscillations associated with straight wires and with open and closed rings. There is also an appendix by Close on the effect of a capacity at the ends of a circular resonator.—*Phil. Mag.*, June.

Occurrence of Radioactive Matter.—J. J. THOMSON.—An account of experiments in which he found that a radioactive substance, apparently radium, is exceedingly widely distributed and occurs in the most unexpected places. For instance, practically all the clays, sands and gravels tested gave off the emanation. The capriciousness of the emanation tells against its being a universal property of all matter, but he believes that most, if not all bodies, are continually emitting a radiation which, like the Röntgen rays, can ionize a gas through which it is passed.—*Proc. Cambridge Phil. Soc.*, April 22; Lond. *Elec.*, June 3.

Electrode Spectra.—LIVEING.—An account of an examination of a number of vacuum spectra made to determine the difference between the anode and the cathode spectrum and to account for the characteristic difference between them. That the molecules of the gas emitting the cathode glow are unaltered in constitution is shown by the fact that in many cases the spectra are reversible. He thinks that the explanation of the solar chromosphere and corona is to be found in regarding them as a huge cathode glow.—*Proc. Cambridge Phil. Soc.*, April 22; Lond. *Elec.*, June 3.

Sparking Poles.—EGINITIS.—An account of a microscopic examination of the poles of spark-gaps, showing the difference in the behavior of poles of different metals.—*Comptes Rendus*, May 16; Lond. *Elec.*, June 3.

ELECTRO-CHEMISTRY AND BATTERIES.

Sterilization of Water by Ozone.—In an editorial correspondence on a visit to municipal plants in Switzerland and Germany, reference is made to the Siemens & Halske plant for sterilization of water by ozone in Wiesbaden. This plant is not now in operation and is held in reserve for such times when the water shows an unduly high number of bacteria. According to the writer, it seems that ozone treatment of water is still too complicated and expensive a process to be employed except in special cases.—*Eng'ing News*, June 9.

Laboratory Resistance Furnace.—A note on electric resistance furnaces for laboratory use, exhibited by Blount at the recent Royal Society conversazione. In one furnace a mixture of graphite and siloxicon is packed in the annular space between porcelain tubes and held between end columns of metal. In another furnace designed by Heræus the resistance is a very thin strip of platinum foil closely applied to the tube to be heated. Temperatures up to 1500° C. can be easily obtained in a short time.—Lond. *Elec. Rev.*, May 27.

Palladium.—AMBERG.—A description of a method of depositing palladium for electro-analytic purposes. He found the use of a revolving anode of great advantage since this enables him to use any current density as long as the e.m.f. is kept below its critical value. There are also some notes on the use of revolving electrodes for electro-analytic purposes in general, for the purpose of accelerating the deposition of the metal desired.—*Zeit. f. Elektrochemie*, June 3.

REFERENCE.

Osmotic Pressure.—HOADLEY.—An illustrated Franklin Inst. paper describing the methods of Pfeffer and Morse for forming semi-permeable diaphragms and for making measurements of the osmotic pressure of a solution.—*Jour. Franklin Inst.*, June.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Dynamometer.—ROSE.—An illustrated description of a dynamometer designed by Renard, which can be easily made at a very small cost and permits to load motors continuously with up to 100 hp and more in a simple and convenient way. It is essentially a windmill, the breaking action being obtained by the air assistance. Renard has determined the laws of this resistance. If a surface of one square decimeter is moved with a speed of 10 meters per second, in air in a straight direction at an average atmospheric pressure and average temperature, the pressure is 85 grams; this pressure increases as the square of the speed and, therefore, amounts to 8.5 kg. for a speed of 100 meters per second; the latter speed is about the higher limit for experiments of this kind. On the motor axle a rod is fixed which carries at its two ends two square plates of aluminum of one square decimeter surface. If the speed of the two aluminum plates is 100 meters per second, the pressure is 17 kg. and the power consumption of this braking apparatus is 1,700 kg.-meters. In his apparatus the length of the rod which carries the two aluminum plates is 1.32 meters, its weight 12 kg., and this apparatus is sufficient for motors of 10 to 80 hp at 600 to 1,300 revolutions. Adjustment is easy by changing the distance of the aluminum plates from the axle of revolution. The power consumption is directly proportional to the weight of one cubic meter of air under the conditions of the test and to the third power of the speed. The method of calibrating the apparatus is described and some numerical examples are given.—*Zeit. f. Elek.* (Vienna), May 29.

Electricity Meters.—An article on recent improvements in electricity meters. An electrolytic meter of Wright and Lux is stated to have distinct advantages over former meters of the same type. The electrolyte seems to be nitrate of mercury through which is passed a certain shunted part of the current to be measured. Metallic mercury is deposited on the cathode in quantities proportional to the coulombs and collects directly in a perpendicular calibrated tube of glass. The anode is a mercury bath of ring form, situated above a platinum cathode in form of a funnel. It is stated that the arrangement is such as to produce a certain and suitable circulation of the electrolyte so that its density is always maintained constant. When a reading of the mercury collected in the measuring tube has been taken, the apparatus is tilted and the mercury is emptied out of the measuring tube back to the anode. A meter of Siemens & Schuckert for double tariff systems is also described.—*Elek. Anz.*, June 2.

Determining the Insulation Resistance.—SAHULKA.—An illustrated description of a method for determining the insulation resistance of a single conductor of a multi-wire system without interruption of the service. The method essentially consists in bringing the partial voltage in one branch of the system to two different values, either by varying the number of the cells in the storage battery connected to the line or by changing the exciting current of the generator; simultaneously the potential of the middle wire is brought to zero value by artificially changing the insulation resistance between one branch wire and the earth; no current is then flowing from the middle wire to earth, which is observed by means of a galvanometer. The two values to which the partial voltage of one wire is brought need to vary only by a few per cent., so that the earthing of an outer conductor is avoided and the test can be made without interrupting the operation. For the three-wire system it is sufficient to bring one partial branch voltage to two different values. For a five-wire system all partial branch voltages must be varied one after the other. The method is described in detail and the formulas for the three-wire and five-wire systems are given.—*Elek. Zeit.*, May 26.

Induction Coil Design.—CODD.—The conclusion of his illustrated article on this subject. He reaches the following conclusions: The core should be in length about 12 times its greatest diameter. The primary should wholly overwind the core, the number of layers being kept small, preferably to a single layer. The secondary should not be made much more than one-third the total length of the core, nor its greatest diameter much more than three times the diameter of its core. The length of the secondary wire should be as short as possible, and the size of the secondary as small as is compatible with good insulation. The condenser should be balanced with the self-induction of the primary and adjustable for varying currents and self-induction. Nearly closed magnetic circuits are not (except for special purposes) at present practicable, but partly closed circuits (e. g., hedge-hogged ends) are advantageous.—Lond. *Elec. Rev.*, May 27.

Microphone Buzzer.—A note on a microphone buzzer, exhibited at a recent Royal Society conversazione by the (British) National Physical laboratory. It is capable of giving a pure note of 2,000 per second. It has been designed for the purpose of giving alternating currents for use in measuring inductances and capacities. It consists of a thick steel rod, supported at nodal points and carrying a light microphone. The microphone is in circuit with the battery and the primary coil of a small transformer. The secondary circuit of the transformer is connected to a polarized electromagnet placed close to the steel rod. Vibrations started in the rod cause ripples in the microphone current, and these in turn give an alternating current in the electromagnet, which by attracting the rod maintains it in steady vibration. For inductance measurements the indicating instrument is a telephone. For high frequencies the telephone is tuned to the proper pitch by a screw pressing against the diaphragm.—Lond. *Elec. Rev.*, May 27.

Units.—BAILY.—A communication in which he says that it is a feature of discussions on practical electrical units that a practical man for whose benefit these alterations are proposed, shows a plentiful lack of interest in the matter. The professor may propose, but the working engineer determines the acceptance of the unit and his tastes are too little considered. Such descriptive units as ampere-turn, kilowatt-hour, ampere-hour, volt-ampere, are easily intelligible and cannot be abolished. There should be exercised a severe economy in the invention of names, only those quantities having individual names which cannot be briefly described in terms of others. If a quantity has a name, its time or space differential required none; or conversely, if a differential is the more convenient; e. g., the ampere; then the time or space integral is needless. On the other hand, nothing would be more confusing than the use of the same unit for different measurements, such as henry, both for coefficient of induction and for permeance. He thinks that permeance should have a name of its own. He agrees with Fessenden that the ampere-turn should be the authorized unit, retaining the c.g.s. unit of magnetic flux and altering the unit of permeance. He deprecates most strongly the substitution of a new name for ampere-turn. He gives some historical notes on proposals made to get rid of the 4π in some formulas.—Lond. *Elec.*, June 3.

REFERENCES.

Testing Recording Wattmeters.—HANCHETT.—An illustrated description of two portable wattmeters for testing. From the customer's point of view the only really satisfactory test is one made over a complete cycle of 24 hours, covering all of the varying loads which are employed in practice on a recording wattmeter. To do this with a voltmeter and ammeter, taking periodic readings, is tedious and expensive, the better method being to use a second recording wattmeter which is known to be correct and install it in series with the first. The wattmeters described are standard instruments with the cases removed and the mechanisms installed in wooden cases

equipped with three adjustable legs by means of which the instruments can be leveled.—*Am. Elec.*, June.

Curve Drawing or Graphic Recording Instruments.—YOUNG.—An illustrated article setting forth the uses of recording instruments in central stations. After describing the various parts of a recording meter and dilating upon the care that should be accorded to each part, the author shows the advantages of the band over the circular form of chart.—*Am. Elec.*, June.

Conductometer.—APPLEYARD.—The conclusion of his illustrated article on the construction and use of his instrument. In an editorial note it is said that the apparatus is of the utmost simplicity of construction and works with a sufficiently high degree of accuracy to fully comply with practical requirements. One of its features is the simplicity with which the necessary unavoidable corrections are made.—Lond. *Elec. Rev.*, June 3.

Factory Tests of Electric Machinery.—WORKMAN.—In continuations of his serial he discusses the methods for testing the regulation of generators.—*Elec. Club Jour.*, May, June.

Block Signaling by Alternating-Current Track Circuits.—A description of the installation on the North Shore Railroad of California, of the first alternating-current block signal system. Alternating current was adopted because it was feared that with a direct-current signal system the return current through the rails would wrongly effect the operation of the signals. The track relay is, therefore, of the induction type and consequently responds only to alternating current.—*St. R'y Jour.*, June 11.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphone.—Some notes on recent types of the Poulsen telegraphone exhibited in London. While the disc pattern apparently has undergone practically no change, various improvements have been made in the wire pattern. Arrangements are now made for switching the apparatus on to the telephone system for the purpose of recording communications during the absence of the telephone owner. A double-pole switch is provided with three positions. In the first position the telegraphone is disconnected from the telephone line altogether; in the second position the telegraphone alone is connected to the telephone system and takes the place of the telephone receiver; in the third position finally the telephone and the telegraphone are both in series and the conversation going on is recorded in its entirety. Assuming a telephone user wishes a call during his absence to be recorded, he moves his switch to position two. If now his number is rung up, an auxiliary device starts the telegraphone motor automatically, which runs for a certain time, the length of which may be regulated. When the apparatus starts, a buzzer is automatically actuated for a few moments and this serves the double purpose of separating the different calls and of drawing the attention of the caller to the fact that the telegraphone is connected up.—Lond. *Elec.*, June 3.

Coherer.—HORNEMANN.—A description of a coherer formed of a single contact between copper and lead in which the copper is oxidized sufficiently to stop any current in the cold, but not sufficiently to stop it entirely when the junction is heated. If, while it is in that condition, electric waves impinge upon it, the resistance in the junction increases, and as soon as the waves cease the resistance falls to the normal amount. This process may be repeated always with the same result as long as the supply of heat to the junction is kept up. This must be done by applying heat to a portion of the copper in the vicinity of the junction, so as not to alter the oxidation. When the strength of the impinging waves exceeds a certain amount, the resistance certainly falls to a very low value and only returns on concussion, whereas in the first case the junction behaves like a self-righting anti-coherer. The author looks for the cause of the action in the thermo-electric force at the oxide junction.—*Ann der Phys.*, No. 6; abstracted in Lond. *Elec.*, May 27.

REFERENCES.

Telephone Inspection Departments.—COAR.—An article pointing out the importance of the expeditious correction of faulty line work or instrument operations in a telephone exchange. The author calls attention to the value of permanent records and gives appropriate forms for many of these. Systematizing of the work of the inspection department is bound to produce good results.—*Am. Elec.*, June.

Telegraphic Transmission of Photographs and Writings.—A description with illustrations of the system of Korn, which has already been mentioned in the Digest.—*Elek. Zeit.*, June 2.

Wireless Telegraphy.—An illustrated article on the arrangements which were made by a German company for reporting the Gordon Bennett race. There were three stations, the principal one being stationary and the two smaller ones portable, being mounted on two-wheeled carts. Their equipment is described and illustrated.—Lond. *Elec.*, June 3.

MISCELLANEOUS.

Electric Heating and Cooking.—KREJŻA.—The first part of an illustrated paper. The advantages of electric heating and cooking are its healthiness, no development of smoke, no danger, continuous readiness, easy adjustment and very great convenience. There is no trouble with buying and storing coal; an electric kitchen can be kept always cool since the heat generated in the cooking apparatus may be entirely consumed in the food to be cooked. The only disadvantage is the high cost of operation. He gives the following data on the cost: If a sitting-room with a content of 100 cubic meters is to be heated to 17° C., while the temperature of the outside is —3° C., he estimates that 3,500 kg. calories are required per hour; with electric heating this means a consumption of 4 kw-hours for every hour, while with heating with coal as fuel, about 3 kg. of coal are required per hour. He records various installations of heating and cooking which have been actually made in sanitariums, spinning mills, and many street railway cars in Switzerland, Germany, Belgium and France; experience has shown that in these cases for every degree Centigrade difference between the lowest outside temperature and the desired inside temperature and for every cubic meter of space to be heated 1 to 1.5 watts of electric power are required; as an approximate average 1.2 watts may be assumed. For instance, if the outside temperature is 10° C. below and a sitting-room of 50 cubic meters is to be heated to 18° C., the difference of temperature is 28° C.; hence, 1,680 to 1,800 watts are required, while the time in which the desired temperature is obtained varies between one and three hours, being, of course, different if the neighboring rooms are heated or not. The Zurich municipal tramway company assumes 70 to 80 watts per seat an hour, if under normal conditions a temperature of 12° to 15° C. are to be obtained. The author begins to give a fully-illustrated review of various heating apparatus made by different companies.—*Zeit. f. Elek.*, June 5.

REFERENCE.

Influence of Anæsthetics on Sources of N-Rays.—MEYER has recently shown that plants subjected to chloroform lose their power of emitting N-rays. Becquerel has now found that other sources of N-rays also suffer under the influence of anæsthetics. Several inorganic sources of N-rays temporarily lose their power under the action of anæsthetics such as chloroform, ether or nitrous oxide. Calcium sulphide which emits N-rays after being exposed to sunlight, shows an enfeeblement of its luminosity when a current of air laden with chloroform is passed over it.—*Comptes Rendus*, May 29; Lond. *Elec.*, May 27.

New Books.

DIE METALLE. By Dr. Bernhard Neumann. Halle: Wilhelm Knapp. 421 pages, illustrated. Price, 16 marks.

This work comprises the history, natural occurrence and method of production of the metals, and includes statistics of the prices and production of the same. This is the first work of its kind, bringing all the widely spread material on the history of metals and their statistics, under one cover; and there is no doubt that Neumann has accomplished his task with great success.

In describing the metals, he first gives an account of the primal findings of the particular metal, then its chemical extraction and its uses by different nations, both at present and in ancient times. Very interesting is the concise way he describes the development of the metallurgical industry in those countries where its production plays or has played an important rôle in the world's output. This book contains a large quantity of highly interesting and useful data and the citations are plentiful, so that one is not left in the dark as to where further information can be obtained on any particular point.

The author has taken special pains to give the full statistics of the

quantity of metals produced in the different countries and the prices of the marketable grades. The statistics are accompanied by curves, which are neatly and clearly carried out. All the curves are in different colors, and when more than one appears on the same sheet, it can very easily be followed up. The statistics published in this work, although not running up to 1904 (mostly only going up to 1902), form one of the special features of the book, and are produced in such a clear manner that they immediately appeal to all who are interested in metallurgical subjects. Thus, for instance, for pig iron the curves are carried out so that one can easily follow the production of this metal in the different countries. Among the interesting indications are the fluctuations which took place when the productions of this country and England were about equal, and it took from 1889 to 1897 before this country achieved a decided advance in its production over England. There are numerous tables which are equally and possibly to some more interesting than the one just cited.

This book does not only appeal to metallurgists and scientific men, but will be found a useful asset in the hands of commercial men. It is written in such a clear and simple way that no one need be afraid that it is beyond the scope of his capabilities.

SWINGLE'S TWENTIETH CENTURY HAND BOOK FOR STEAM ENGINEERS AND ELECTRICIANS. By C. F. Swingle. Chicago: Frederick J. Drake & Co. 497 pages, 110 illustrations. Flexible leather cover with pocket. Price, $2.50 net.

This is a handsomely got up manual or compendium laid out on broad lines and embracing a good deal of useful information, but not a "pocket book" in the ordinary sense of the term, although nowadays some pocket books that an engineer is supposed to carry around with him are as large as family bibles. It is virtually a treatise on what might be termed steam and electric isolated plant practice, the steam data being, of course, generally applicable to central station work, or to plants without dynamos. The steam engine section has questions at the end of each chapter, but we do not find any at the end of the chapters in the electrical section. Under steam, special attention has been paid to indicator work, evaporation tests, etc., and in Chapter III problems and calculations in hydraulics are worked out in plain figures in place of algebraical equations. The typographical treatment also, throughout, is that of an ordinary book rather than a pocket book with its acres of fine figures. In both sections diagrams are freely used and the dynamo tender, fireman or oiler is enabled to grasp the subject matter readily and take up next something more abstruse.

Moving Pictures at the World's Fair.

Not the least of the attractions of the World's Fair will be the exhibition in the private Westinghouse auditorium on the fair grounds of moving pictures of scenes in and about the Westinghouse Works at Pittsburg.

Recently an attractive exhibition was given at Carnegie Hall prior to forwarding the apparatus to St. Louis, and it is stated that the moving pictures were much more successful than those usually exhibited. The great success is ascribed to the perfection of the photographs taken for the purpose by means of the Cooper Hewitt lamp. When moving pictures of a celebrated prize fight at Coney Island were taken, 400 arc lamps were strung about a 20-ft. ring, whereas in several of the Westinghouse pictures the entire length of a quarter mile of aisle was photographed and only 61 mercury vapor tubes were used to secure the illumination.

In addition to many shop views of the works of the Westinghouse Electric Company, the Westinghouse Machine Company, the Westinghouse Air Brake Company and the Westinghouse Machine Company's foundry, are a five-minute view of a train departure at East Pittsburg, at the close of the day, and a view of a train approaching a signal tower, showing the operation of automatic interlocking apparatus.

Among the interior views exhibited is one showing the welding of a 10-ft. ring for a 1,500-kw generator, another showing the employees lifting pass checks at the end of the working day; still others show the assembling and testing of a 1,500-kw rotary converter, the testing of gas and steam engines and steam turbines, winding field and transformer coils, etc. More than 20 moving pictures will be exhibited.

Expert Advice in Power Equipment of Factories.

The Crocker-Wheeler Company has announced that it is now prepared to give its clients expert advice upon the latest ideas and results in shop practice, in addition to purely engineering advice upon the design and installation of electrical apparatus for shop equipment. To this end it has retained the well-known firm of Dodge & Day, modernizing engineers, of Philadelphia, Pa., and places the services of this firm at the disposal of its customers, giving them gratuitously the benefit of their wide experience and data. The experience of the electrical engineer alone does not fully cover the numerous factors that are met in these days in the dividend-making management of machine shops. While the great economies that may be effected by electric drive are conceded by all, the actual savings accomplished depend entirely upon the intelligence with which the apparatus is selected, installed and used. The advice and recommendations about which its customers may consult this firm are not confined to electrical details, but may include all problems of shop equipment and management.

Extension of the Issy Generating Station, Paris.

The company which supplies electric light and power in the areas on the left bank of the Seine at Paris has decided to extend its generating station at Issy. Four alternators of 600 kw each are to be installed in place of the former units, the latter being now too small to cope with the increased demand for energy.

Each generating set will consist of one Westinghouse single-phase alternator, 3,000 volts, 42 periods, direct-connected to one of the existing horizontal steam engines, which have a capacity of 800 hp each. They will be put into service successively, in order not to interfere with the working of the station. The exciting current for each unit will be furnished by a 25-kw exciter, at 125 volts.

Each alternator will be fitted with a special fly-wheel weighing about 7.7 tons, which will about double its inertia. The spider will be cast in two pieces, so that it may be mounted direct on to the shaft of the engine, without removing the bearings.

When the extension is complete the center aisle of the Issy station will contain ten generating sets, five of which will have been supplied by the French Westinghouse Company. One Westinghouse alternator was installed in October, 1903, on trial, and it is due to the perfect running of this machine that the order has been placed for the four new machines, which are now under construction.

An Electric Automobile Record.

The Providence *Journal* gives an account of an electric automobile run recently made from Providence to Boston and return, a distance of 95 miles, on a single charge of battery. The run was witnessed by Mr. F. F. Shaw, chief engineer of the Providence *Journal*, who checked the results. Two electric vehicles were used, the smaller being a Waverley runabout provided with 22 cells of battery and a 2½-hp motor, and the larger a Columbia fitted with a body designed for 40 cells and having a 3-hp motor. Both vehicles were supplied with Porter batteries manufactured by the Rhode Island Electromobile Company. When conditions were favorable speeds of 15 or 20 miles an hour were made. On level roads the discharge averaged 30 amp. and on hills reached 60 to 70 amp. with a maximum of 100 amp. on a steep grade.

The weight of each cell of battery was 29 pounds, or 928 pounds for the 32-cell battery in the Waverley runabout. The above rates of discharge refer to this battery. The battery was tested by Mr. Shaw and the drop of voltage at the end of the run was found to be 8 volts. The running time from Boston to Providence was 3½ hours. The batteries had been in constant use for 18 months prior to the run, and during that time had never been cleaned, repaired or even opened. After the Boston run they were opened and examined with the intention of making repairs, but it was found that the plates were absolutely intact. As there was scarcely any deposit in the bottom of the jars, the cells were not even cleaned out, but were replaced exactly as they were taken out. It is claimed that this record of a 95-mile run on one charge with the batteries not exhausted at the termination is the best that has been thus far recorded.

A Tannery Electric Power Equipment.

The adaptability of electricity to different conditions is shown to great advantage in tanneries equipped with electric power. The unavoidable dampness or dust in nearly every tanning process are difficulties that confront the electrical engineer. An example of a tannery, only recently equipped with electric power and steadily increasing with excellent results its application of electricity, is the plant of the Henry Lang Company, on Seventeenth Avenue, Boyd and Lillie Streets, Newark, N. J. The company makes the highest grade patent and enamel leather, in a variety of colors, besides a line of less expensive goods.

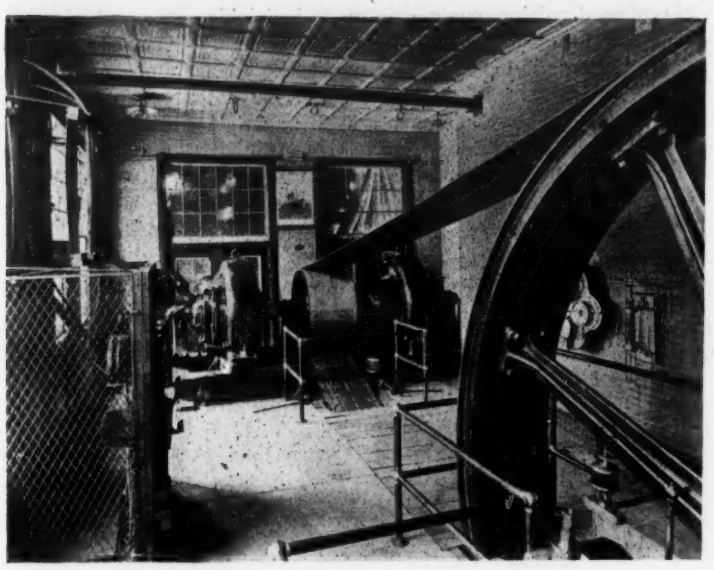


FIG. 1.—GENERATING PLANT.

A plant of this sort must necessarily spread over a considerable area. When steam driven, at least 40 per cent. of the power is required to set the belts and shafting in motion before the machines can do any work at all. In the transmission of power from generator to motor there is only a fraction of this loss; and it is no longer necessary to crowd buildings together for the purpose of saving power. Many of the processes require light, which is easy to supply when countershafts and belts are eliminated and electric lamps can be hung at convenient points.

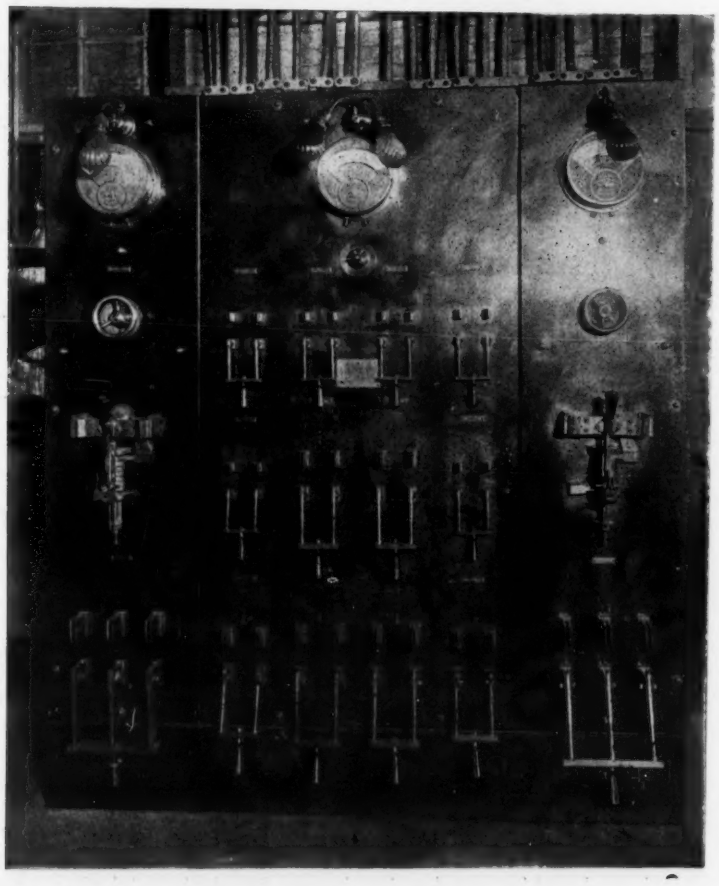


FIG. 2.—SWITCHBOARD.

The electric power plant, which superseded the old steam plant, was installed and started without the loss of an hour's time. It consists of two compound-wound 75-kw Crocker-Wheeler generators, of the direct-connected type, but arranged, with a central pulley, for belting. These are driven at a speed of 275 r.p.m. by a Watts-Campbell 200-hp 18-in. by 42-in. steam engine with a 16-ft. by 30-in. flywheel at 75 r.p.m., carrying the belt.

The switchboard is built in three panels. The left-hand one supports a Walker Keystone ammeter, a Ward Leonard rheostat, an 800-amp. Cutter "I. T. E." circuit-breaker, and an equalizing switch for one of the generators. The right-hand panel is similarly equipped for the other generator. On the center panel is a Walker Keystone voltmeter, twelve 250-volt switches, six of 100 amp., two of 200 amp., two of 300 amp. and two of 400 amp. rating.

Two 150-hp tubular boilers supply steam to the engine and to maintain a high temperature in the japanning ovens. The boilers are for the most part stoked with damp bark that has been used for tanning, supplemented with soft coal. Exhaust steam is used to heat the buildings in winter and the hide drying lofts all the year around.

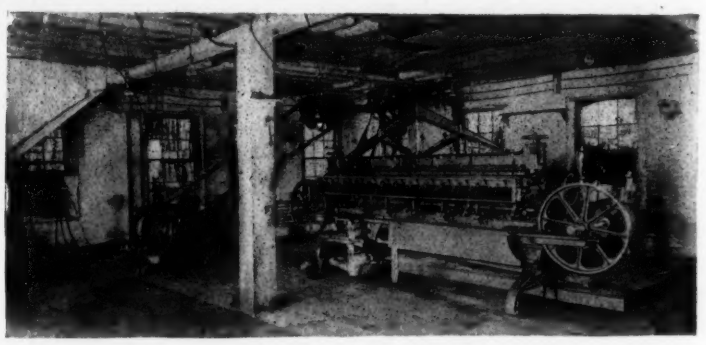


FIG. 3.—MOTOR-DRIVEN KNIFE SPLITTER.

The processes in the Lang plant are, briefly, as follows: The wet salted hides, arriving from Chicago, are taken from storage to the beam house. Here they are placed on the sloping convex tables called beams, and the fat is brushed off. After lying for the next seven or eight days in a solution of lime and cold water, the rest of the flesh and the hair are removed. They are then thrown into pits containing a patent "bate," or softening solution, which is kept in motion by paddle wheels. They are left there for twenty-four hours. The five paddle wheels that stir up the liquid in these pits are driven by a 10-hp motor wound for a voltage of 115, at 850 r.p.m. The wheels are 5½ ft. long and 5 ft. in diameter, each having twelve paddles. Washing in fresh warm water follows the "bating." The hides are then ready for tanning, of which the first step is coloring. They are immersed for some time in coloring liquor, which is agitated by five paddle wheels, similar to those just described, belt-driven by a 10-hp motor on the floor above, removed as far as possible from the dampness. The hides are exposed in a series of pits to chestnut oak bark liquor of increasing strengths. They are handled once a day during the first week, after that more frequently. This process takes about three weeks. Two centrifugal pumps, which can empty a 5-ft. by 5-ft. by 7-ft. pit in two minutes, with a 3-in. suction, are used for pumping the liquor and are run by two 7½-hp motors, also on the floor above. The starters for these motors are, of course, on the lower floor.

When the tanning is completed the hides are folded, half dried by pressure, and conveyed up stairs to the stoning machines. There are four similar machines for stoning, pebbling and graining, driven through a countershaft by a 10-hp motor, which is wound for a voltage of 115 at 850 r.p.m. The stoners pound out the damp hides and remove wrinkles. At this point each hide is inspected and trimmed. Scars from wire fence or horn wounds are shaved down by hand.

The next process is splitting the hide into four or five thicknesses. Two American Tool & Machine Company's belt knife splitters are provided, driven by two 20-hp motors having a speed of 775 r.p.m. Each is a full-hide machine equipped with a moving endless knife capable of making a cut 106 in. long, which knife is constantly being resharpened by a pair of nearly tangent emery wheels revolving in

opposite directions at 2,200 r.p.m. The output of each machine is about 120 hides a day, with three or four cuts to the hide. Before starting it is necessary to test the tightness of the knife. As this is done by hand, the machine is belted instead of direct-connected to the motor.

The outside, or grain side of the hide, after being stained and finished is made into patent leather for shoes and shoe tips. The next thickness, called the deep buff, works up into carriage or enamel leather. The split is also good for enamel leather, as is the second split, if the hide has substance enough to yield two splits. The flesh side thickness is called the slab and is not used in this tannery. It is largely exported to European manufacturers of coarse boots and shoes.

The grains, deep buffs and splits are dropped through a trap door, into the scouring house or re-tanyard, where they are put into revolving drums 6 ft. in diameter by 4 ft. in width, holding a secretly compounded liquor of suitable temperature. The seven drums are driven at a speed of 10 r.p.m. through a countershaft by a 10-hp motor having a speed of 850 r.p.m. After being taken from the drums each hide is set out on a table and stuffed with oil to give the leather substance. Being ready for stretching, they are fastened, horse-blanketwise over tacking frames and left in a drying loft for two days. A Blackman's 48-in. diameter ventilator wheel, driven by a 10-hp, 800-r.p.m. motor exhausts hot air into the lofts from another drying room on the ground floor, thus supplying three drying lofts with the necessary hot air.

Another loft is fitted with steam pipes and two ventilator exhaust wheels like the one mentioned, driven by a 15-hp motor, running at 800 r.p.m. After drying they are sorted, and the best grain hides go to the slicker buffers, who with parallel edge knives prepare the surface for japanning. The hides are made soft and pliable by being worked in a special softening machine, which does the work of ten men, and is driven by a 10-hp motor, having a speed of 800 r.p.m. Small holes are patched and the hides are counted and spread out flat on dry tacking frames ready to be japanned.

The hides then receive alternate coats of "dub" made of linseed

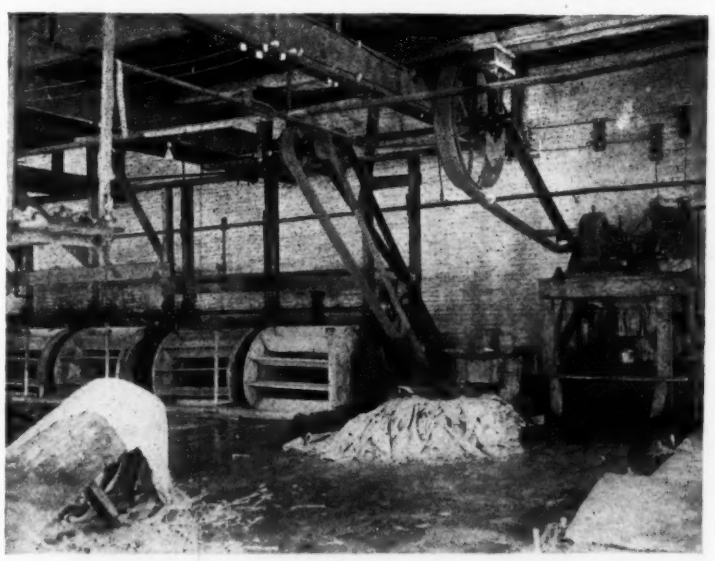


FIG. 4.—MOTOR-DRIVEN PADDLE WHEEL.

oil, lamp black, etc., being dried in the sun. The finishing department puts on several coats of varnish and whatever tackiness the leather may show is removed by another drying in the sun. Finally, the hides are taken off the frames and sent to the currying shop to be grained or pebbled.

The whole time spent in producing a perfectly cured patent leather hide is about six weeks as against as many months by the old methods. This time is saved through improved methods in tanning, handling and, in fact, in all the various processes the hides undergo.

There is probably no one factor which has accomplished so much toward modernizing the tanning as the use of electric power, an agent which is rapidly being adopted in manufacturing plants of every kind for its simple transmission, applicability to light or power and ready attachment to any sort of machine.

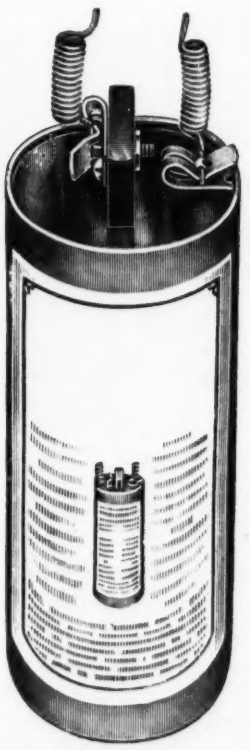
The Turbo-Electric System in Mining Work.

The Newhouse Mines & Smelting Company, of Frisco, Utah, has adopted Westinghouse steam turbines and electrical apparatus for furnishing power in its mining operations in Utah and for local lighting. A notable precedent had already been established in the mining field by the adoption of turbines of the same make by the De Beers Mining Company, Limited, South Africa, where two 1,000-kw Westinghouse-Parsons turbines are already in operation and a third is under construction.

The Newhouse Mines & Smelting Company's new power station is situated twelve miles from Frisco, Utah, at the terminus of the Oregon Short Line Railroad, which is now under construction. Electric power will be used for operating the mining machinery and also to furnish light for the town of Newhouse. Power will be generated at 440 volts and transmitted at 2,300 volts a distance of 9,000 ft. from the power plant to the mines, where it will be stepped down to 400 volts for the motors in the concentrating mill and crushing department, situated at the mouth of the tunnel. Power will also be used to drive a motor-generator set for the operation of mining type locomotives in the main tunnel. The entire electric system is three-phase with a frequency of 60 cycles.

The generating plant consists of two 400-kw Westinghouse-Parsons turbines with three-phase generators of like capacity. The turbines will operate under 150 pounds pressure, 27-in. to 27½-in. vacuum, and approximately 80° F. superheat at the turbines. An individual surface condenser will be provided for each turbine. The boiler plant will consist of three 280-hp B. & W. boilers operating at a steam pressure of 155 pounds gauge, with superheat at the boilers of 100° F. The plant is being erected and equipped under the charge of Mr. Robert F. Moser, M. E.

Dry Battery Binding Post.



BINDING POST.

In considering the question of dry batteries, at first glance it would seem difficult to imagine a more simple or convenient method of connecting the wires to them than by the usual screw and nut so universally found on this type of cell. The Fahnestock Transmitter Company, of 132 Havemeyer Street, Brooklyn, N. Y., claims, however, to have made an improvement and the accompanying illustration shows a dry battery equipped with the new spring binding post this company is placing upon the market.

In this connector the wire is gripped by the action of a spring, and it is claimed that all possibility of a loose contact at the battery is eliminated, and that the wire can be put in or taken out in one-tenth the time it takes to adjust a screw post. The connector will grip any size wire up to No. 12 B. & S., and in making the connection no screwdriver or pliers are needed. The company recommends this connector on dry batteries for use on automobiles, as it claims that no amount of vibration or jar will affect the contact.

Accident in West Indies.

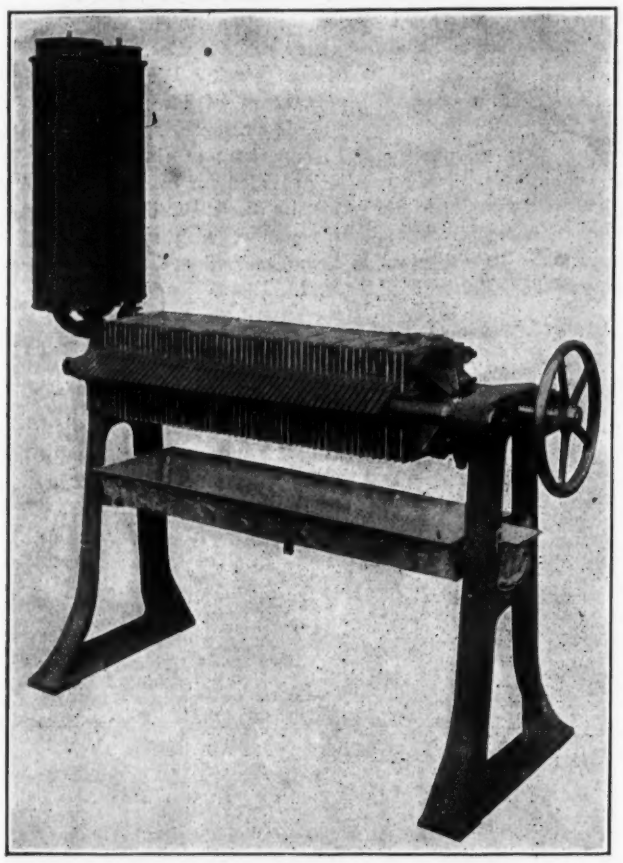
On June 27, at Kingston, Jamaica, thirty-four men were drowned and seventeen are missing as the result of the accidental flooding of a large pipe leading from the electric power house at Bogwalk. Sixty-seven men were engaged in cleaning the pipe, when, through some accident, water was turned into it, and the men were washed into the river. Sixteen of them are known to have escaped.

Electrolytic Production of Hydrogen and Oxygen.

The production of hydrogen and oxygen gases by electrolysis of water begins to become of considerable industrial importance in Europe, as is indicated by the various types of apparatus made by different companies there. One of the most recent apparatus is that of the Oerlikon Company, which we illustrate herewith.

The electrolyzers of this system absorb, according to their size, up to 30 hp, the voltage being up to 250. The apparatus is composed of a certain number of successive electrolyzing cells, the electrodes being brass plates. The insulation of the different plates is obtained by diaphragms, which serve at the same time to insure the perfect tightness of the cells.

The gases formed at the surface of the electrodes escape through holes in the plates, which communicate with two longitudinal canals that lead the gases to the separators. After the separation of the gases the liquid is led back into the cells through a single conduit. The development of the gases, due to the passage of the current, produces a continuous circulation of the liquid. The liquid consists of a 10 per cent. solution of carbonate of potassium. The normal



ELECTROLYZER FOR MAKING HYDROGEN AND OXYGEN.

construction permits of obtaining the gases under a constant pressure, the value of which may be equal to the pressure of a column of water 2½ meters in height.

On account of the simplicity of construction a rapid cleaning of the apparatus is possible. If the apparatus is in continuous operation, it is necessary to clean it at intervals of about eight weeks. All the attendance which is otherwise necessary to get good operation is to fill it at intervals with distilled water to replace the water which has been decomposed by the current.

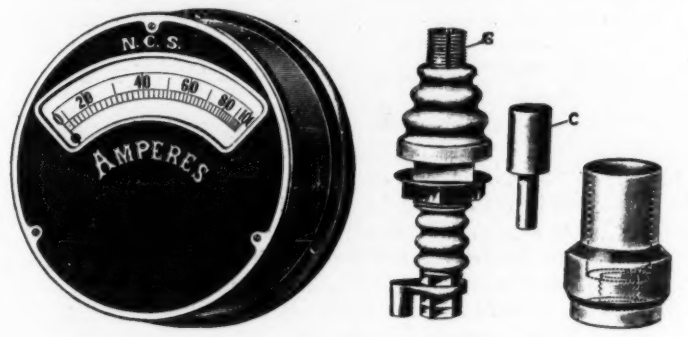
The apparatus will decompose 134 grams of water per kw-hour and produce 168 liters of hydrogen and 84 liters of oxygen. With elevated temperature the output is raised by 8 per cent. The purity of the oxygen is on the average 97 per cent., the 3 per cent. impurities being hydrogen and traces of carbon monoxide. On the other hand, the hydrogen produced contains only 1 per cent of oxygen. By a special and quite simple device it is possible to obtain the gases in a perfect condition of purity.

When cold the electrolyzer requires about 2.7 volts per cell. At a higher temperature 2.3 volts are sufficient. After eight hours of continuous run, the temperature attains its maximum value, which is 60° C. If an average price of 1.2 cents per kw-hour is assumed, the production of the cubic meter of oxygen costs 14.5 cents, and that of the cubic meter of hydrogen 7.2 cents. This price is pretty low if one considers that a cubic meter of hydrogen obtained by chemical action (the reaction of sulphuric acid on zinc or iron) is 50 cents. Numerous plants have adopted this process in Switzerland and other European countries.

Transformer Instruments for High-Pressure Switchboards.

In the design of high-pressure switchboards it is a point of some importance that the instruments themselves should not in any way be connected to the high-pressure side of the system, so that there can be no danger of shock to the switchboard attendants. The instrument shown by Fig. 1 fulfills this requirement; it is of the iron case type, with nickeled front, fitted with an air-damping device, which makes it perfectly dead beat.

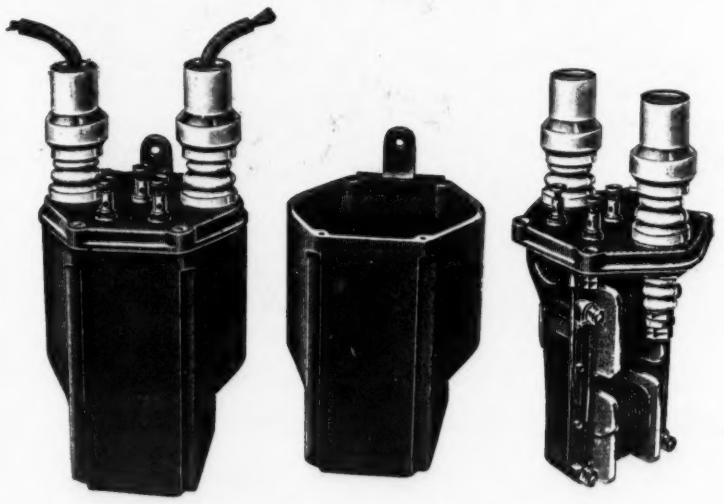
Instruments of this type are used either as voltmeters or ammeters, through transformers, one of the latter type being shown



FIGS. 1 AND 2.—TRANSFORMER INSTRUMENTS.

in Fig. 3. The design of these instruments is such as to provide the requisite insulation, and also for convenience in connecting up.

The high-pressure terminals are so arranged that the cable can be sweated straight into the socket, *C*, Fig. 2, which is inserted into a split screw, *S*, in the top of the iusulator; the whole is covered by a porcelain cap, into which is cemented a nut which can be screwed up, thus clamping the cable socket immediately on to the transformer terminal. This porcelain cap completely covers the



FIGS. 3 AND 4.—TRANSFORMERS.

socket and the part of the cable which is sweated into it, so that there is absolutely no danger from shock in handling the transformer.

The transformers are contained in iron boxes, Fig. 4, which are filled with oil, and are suitable for pressures up to 10,000 volts; they are small and compact, and are fitted with lugs, so that they can be easily screwed to the back of the switchboard, or to any other suitable support. They are so designed as to give a constant ratio under all conditions. The above instruments are manufactured by Nalder Bros. & Thompson, 34 Queen Street, London, England.

The Exhibit of the General Electric Company at the Lousiana Purchase Exposition.

The General Electric Company's exhibit at the World's Fair in St. Louis has been carefully selected to avoid the warehouse idea as much as possible, and, as a consequence, only a few examples of this company's most representative work have been shown. One of the first striking features at its space in Electricity Building is the full-sized model of the 10,000-hp vertical shaft generator, as built for the large Canadian power plant at Niagara Falls. There are five of these machines being installed, these being the largest dynamos ever constructed. The model represents the stationary armature of the machines resting on a concrete base. Inside there is a small circular room, where are photographs of the Niagara Falls electrical installations of the General Electric Company. This room also serves to show lighting effects with the three different types of lamp offered by the General Electric Company, namely, the "Meridian" incandescent with prismatic reflector, the enclosed arc with concentric diffuser, and the orthochrome mercury vapor arc lamp,

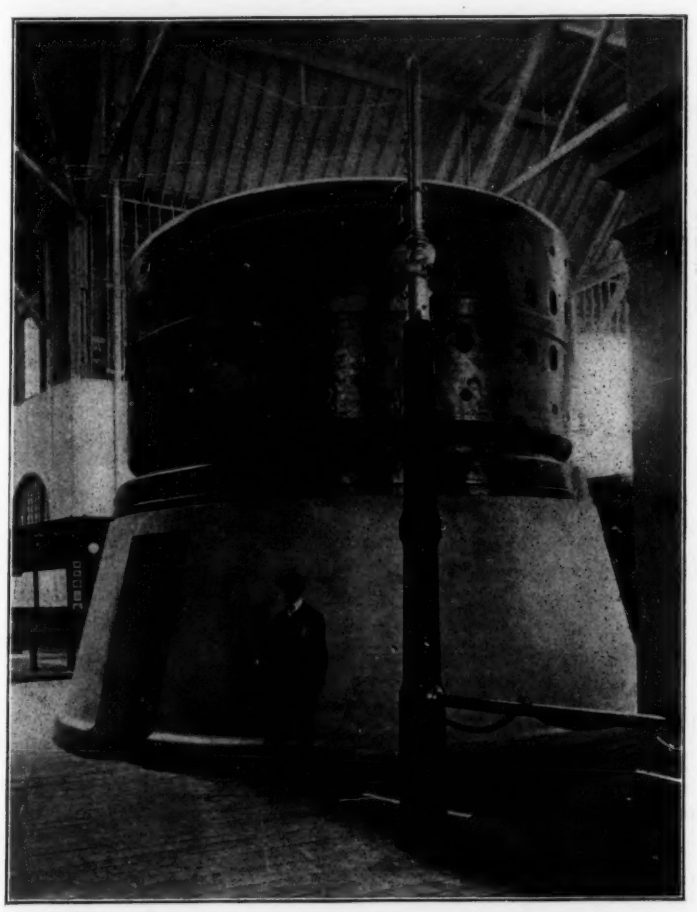


FIG. 1.—MODEL OF 10,000-HP VERTICAL SHAFT GENERATOR.

which is a lamp combining the light of the mercury vapor arc and incandescent filament in one lamp.

The Steinmetz mercury vapor arc lamps are exhibited for the first time, and the central tower of the exhibit is surrounded by a circle of these mercury vapor tubes. The tubes of the lamps shown in this exhibit are 16 in. long by 1 in. in diameter. The current taken by a tube in operation is 3½ amp. operating on a direct-current circuit on 125 volts. The excess voltage above the 65 required by the lamp is taken by a steadying resistance of some sort. In the type of lamp known as the monochrome the energy used in this steadying resistance is wasted. In the orthochrome mercury vapor lamp three incandescent lamps in multiple are used as a steadying resistance and placed alongside the mercury vapor tube. The tube and incandescent lamps are all enclosed in a Holophane globe. The incandescent lamps serve to supply some of the red rays, which are entirely lacking in the mercury vapor lamp, so that the light resulting from the combination of incandescent filament and mercury vapor lamp is unobjectionable. The starting of these mercury vapor lamps is done automatically in a very ingenious manner. In the bottom of the lamp is a small iron plunger floating on the mercury. The plunger normally makes contact between the mercury and a carbon filament. The filament runs the length of the tube and connects to the top electrode. A solenoid coil surrounds the bottom of the

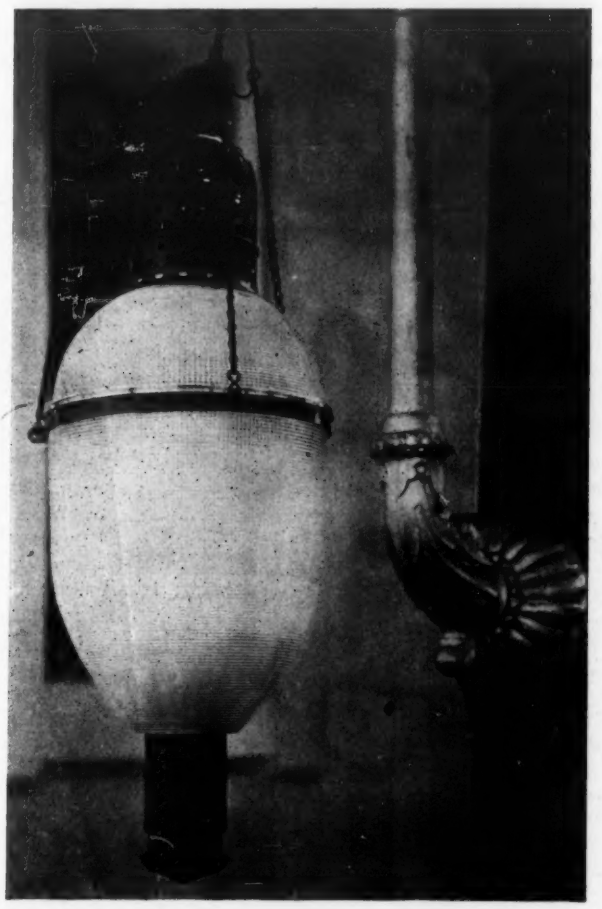


FIG. 2.—MERCURY VAPOR LAMPS IN HOLOPHANE GLOBE.

tube, and when the current is turned on it pulls the iron plunger down, so that a small arc is drawn between the end of the carbon filament and the mercury in the bottom of the lamp. This arc instantly starts mercury vapor, which causes the mercury vapor arc to start, and as the mercury vapor arc is of much lower resistance than the carbon filament and the arc at the lower end of it the latter is extinguished. The new luminous arc lamp using magnetite instead of carbon can also be seen in this exhibit.

In the railway portion of the exhibit the Sprague-General Electric multiple-unit train control system as perfected for the Interborough Rapid Transit Company, of New York, is shown, with car bottom elevated for convenient inspection. This is the same in general appearance as previous forms of type M control made by the General Electric Company. The contractors, however, are considerably heavier than in previous forms, and the controller has an automatic restricting appliance to prevent motormen turning on the current so rapidly as to exceed a certain predetermined amount. The controller drum is connected to the controller handle shaft through a long spiral spring. A magnetic clutch acts to prevent the controller drum from advancing when the current in one armature of the car equipment exceeds the amount for which a current limiting relay in that armature circuit is set. When such excessive current flows, the relay closes the circuit through the magnetic clutch which holds the controller cylinder from advancing until the current value falls enough to release it. The controller handle can be advanced as rapidly as desired, but the controller drum will only advance as fast as the relay coil will allow. In connection with this controller there are two General Electric 69 motors mounted on a Hedley truck. A third motor of this type is shown open for inspection. This is the motor used by the Interborough Rapid Transit Company. Another type of a recent railway motor, General Electric 70, is shown, this being the same as those used on the Intramural Railway of the Exposition.

Five different types of railway controllers are shown. A type P 14 air compressor supplies air for cleaning machinery about the exhibit.

The General Electric Company's straight air brake system for electric cars is shown for the first time. The application of induction motors to cotton mill driving is illustrated by a 100-hp induction motor suspended overhead and belted to four lines of shafting; two belts being run from each end of the motor shaft. In connection with this is an improved starting switch with a curve-drawing wattmeter. The application of electric motors to hoisting is shown by a double-drum Lidgerwood machine hoist electric motor and controller.

A 7-ton mining locomotive is equipped with a cable reel which automatically winds as the locomotive advances or backs up. This new

FIG. 3.—PART OF GENERAL ELECTRIC EXHIBIT.

cable relay is a feature over which mining men are enthusiastic, as it allows electric locomotives to be run into new portions of the mine where trolley wires have not been installed, and at the same time does not permit the cable to become tangled up or run over by the locomotive, as it frequently is where the winding up of the cable is left to the men operating the locomotive. The cable drum contains 700 ft. of cable, and the locomotive automatically winds this up. The cable drum is geared to the locomotive axle through the medium of a friction clutch, which allows a certain amount of slip but does not let the cable get entirely slack.

Close to the model of the largest generator ever built is one of the largest oil switches yet constructed, to break a 60,000-volt circuit. A view of this oil switch accompanies this article. Another large piece of apparatus is a 2,333-kw transformer, built to operate with a 2,300-volt, low-tension and 55,000-volt, high-tension voltage. This is one to be used in the Spokane (Wash.) transmission. Two coils of this transformer are shown outside the transformer to illustrate the method of construction. One of these is partially completed, and the other completed. The coils are wound of copper strip, with heavy strip insulation between convolutions. The principle of air-cooled transformers is shown by a 250-kw transformer of this type mounted over an air chamber, the air pressure in the chamber forcing the air through the transformer. There are also type H oil-cooled transformers.

A great number of small motor applications are shown, including a 24-in. electrically-operated Chapman valve, centrifugal sugar-drying outfit with direct-connected vertical shaft motor, portable drilling outfit with flexible shaft, alternating and direct-current sewing machine motors, electric motors, electric coffee grinder, electric buffing and grinding machines, electric meat chopper, horse-clipping and grooming machine, force blower, job printing press, automatic envelope printing machine and a regular drill press. Voltage regulators, types TA, TD and AR, are in operation with loads which

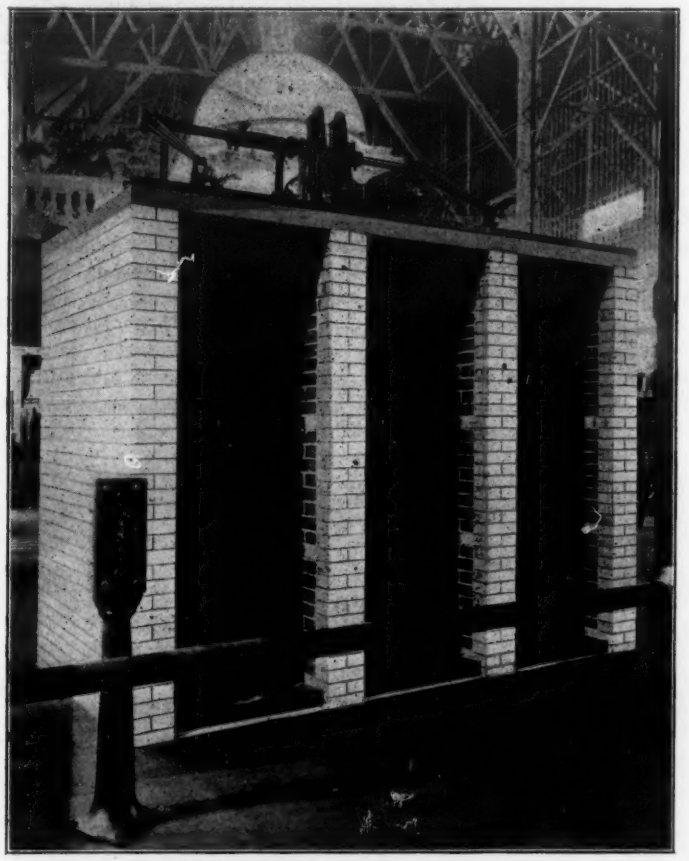


FIG. 4.—60,000-VOLT OIL SWITCH.

may be varied. An 18-in. searchlight electrically controlled from the main floor surmounts the tower of the company's office booth in the middle of the exhibit. The latest products of the company in wiring

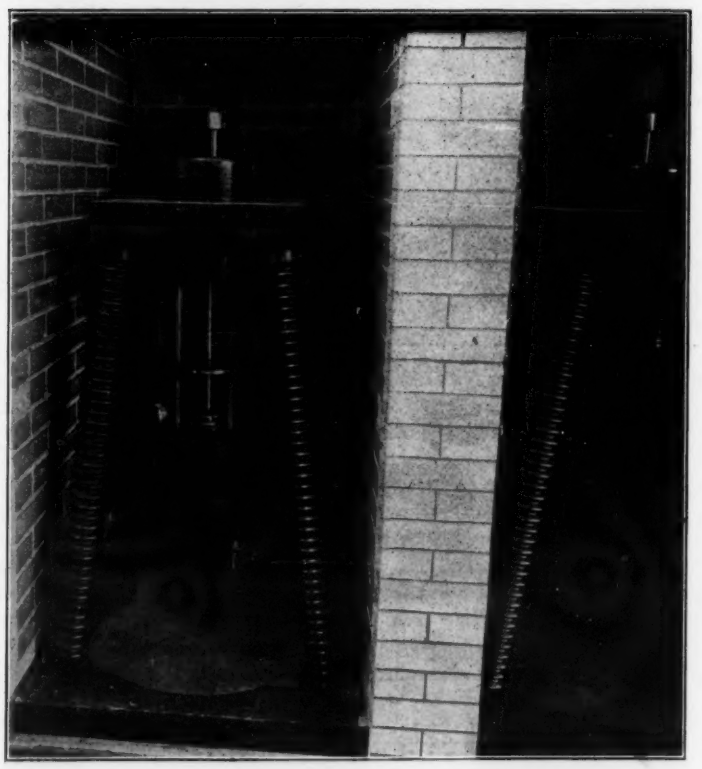


FIG. 5.—60,000-VOLT OIL SWITCH.

supplies, lamp sockets, insulators, cabinet panels, with all its classes of small work, are shown, but space does not permit a minute description of all improvements made in these small parts. An apparatus whereby a large number of condensers are charged in parallel and

discharged in series so as to give one million volts is being set up, to be used in testing lightning arresters with a discharge similar to lightning discharge. Typical railway and lighting switchboards of several types are used in operating apparatus in the exhibit.

A mercury vapor rectifier with a capacity of 10 amp. direct current is shown side by side with a motor-generator set for doing the same work, the cost of which is double that of a mercury vapor rectifier. This rectifier takes single-phase alternating current at one pair of terminals and delivers direct current at another pair. The one shown in the exhibit (a photograph of which mounted on a small switchboard panel is reproduced herewith) receives 220-volt alternating current at 60 cycles and delivers 70 volts direct current. The efficiency of the rectifier is 75 per cent. The maximum capacity of a rectifier output is 10 amp. direct current. If more than 10 amp. are wanted, more tubes are added. When operating on a 125-cycle supply, the direct current from this rectifier does not pulsate to

FIG. 6.—2,333-KW TRANSFORMER.

exceed 10 per cent. The rectifier is used in operating a 7½-hp motor. The alternating-current terminals of this mercury vapor tube (which tube may be considered to represent the upper legs of a Y) are connected in parallel with a small reactance coil across the alternating-current supply mains. The mercury, which is in what may be considered as the bottom leg of the Y, is connected to one direct-current terminal. The other direct-current terminal is connected to the middle point of the reactance coil. The mercury vapor is started by an arc between the mercury in the bottom of the tube and a small terminal in a short leg of the tube located near the bottom. The tube is shaken slightly, either automatically or by hand, which starts an arc between the two bottom terminals. This arc is immediately cut out and the top terminal substituted. The rectifier is then in full operation.

In one corner of the exhibit is a "tub" transformer with case removed showing the General Electric series alternating arc system. The 25 arc lamps supplied by this transformer are used about the company's exhibit. This is the system used by the Exposition for lighting the interior of the Exposition buildings, the Pike and outlying portions of the Exposition grounds. In connection with the arc lamps, the concentric diffuser is, of course, shown, and also a new white ceiling of metal, for use with arc lamps, to improve the general illumination.

The exhibit of measuring instruments is especially interesting because a number of this company's new curve-drawing wattmeters and voltmeters are shown as well as the regular indicating instru-

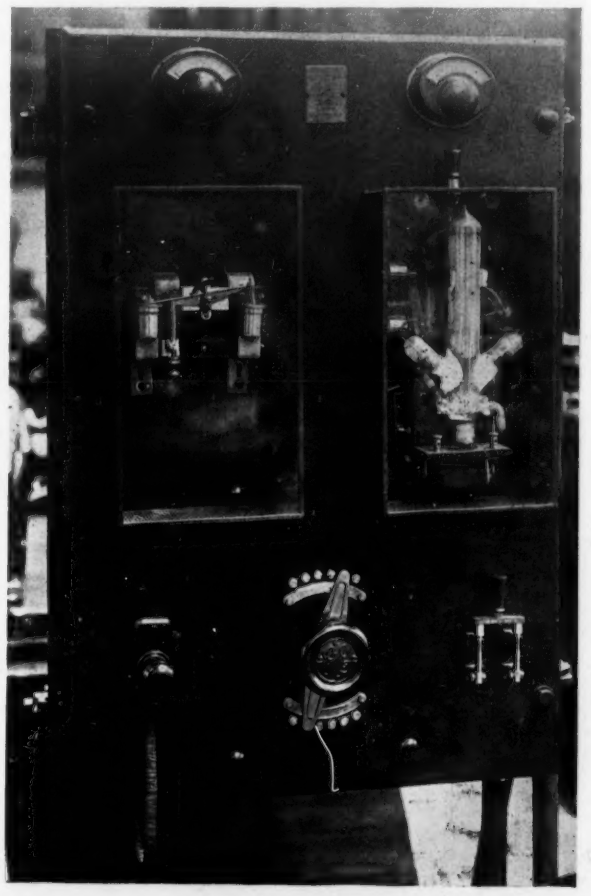


FIG. 7.—MERCURY VAPOR RECTIFIER.

ments. A Thomson high-torque induction recording wattmeter is connected with a bank of lamps to show its operation on from one

FIG. 8.—GENERAL VIEW, WITH "TUB" TRANSFORMER IN FOREGROUND.

to sixty 4-cp lamps. The Thomson prepayment wattmeter can also be seen as well as the new designs of Thomson recording wattmeter in different capacities.

Colorado Electric Light, Power and Railway Association.

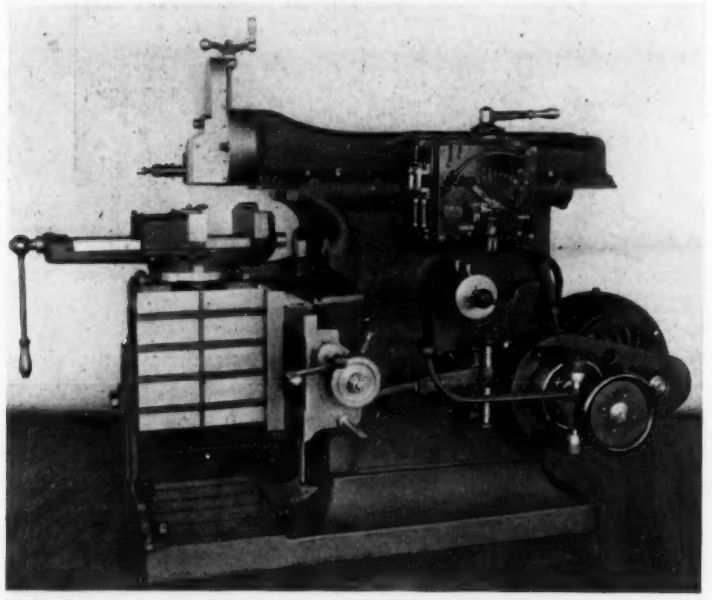
Secretary George B. Tripp, of the Colorado Electric Light, Power and Railway Association, informs us that the next annual meeting of the Association will be held at Colorado Springs, September 21, 22 and 23, 1904. The secretary's address is Colorado Springs.

Speed Test of Shaper.

It will be of interest to both electrical and mechanical engineers to note the table given below, showing the result of a speed test made upon a Gould & Eberhardt "double triple quick" stroke shaper, equipped with a 3-hp, 220-volt Northern Electrical Manufacturing Company variable speed motor and a Ward Leonard Electric Company "S. K. R." type of combined field rheostat and motor starter:

Number of field rheostat contacts.	Speed of motor in rev. per minute.	Strokes of shaper at belt speed.	
		Geared for high speed.	Geared for low speed.
21	1596	110	29
20	1497	101	28
19	1380	97	26
18	1355	94	25
17	1260	89	24
16	1203	84	23
15	1130	77	21
14	1095	74	20
13	1047	69	19
12	993	65	18
11	934	62	17
10	885	58	16
9	845	56	15
8	785	52	14
7	733	48	13
6	654	45	12
5	595	42	11
4	530	36	10
3	465	31	9
2	367	26	8
1	315	22	7

The test was made under condition of no load. The field rheostat had a total resistance of 1,000 ohms and an ampere capacity 1.75



ELECTRICALLY-DRIVEN SHAPER.

maximum. It is of interest to note the even increments of speed change per step. In the field rheostat it is approximately one stroke per minute, and a speed variation slightly greater than five to one was obtained by field control only.

The accompanying illustration shows the complete equipment. The connection between the motor and the shaper is by means of a Morse silent chain drive. The cut also shows the clutch and brake arrangement controlled by the long curved lever pointing towards the front of the machine. One movement of this lever, which operates a friction clutch and brake at the same time, instantly stops the ram at any part of the stroke without having to stop the motor and wait for it to run down; and the reverse movement starts the machine up again at full load. This not only is a very valuable feature of the machine for the operator in setting, adjusting and examining work, but also saves wear and tear on the motor from frequent stoppage.

Steam Turbines in Central District Heating and Lighting Service.

The Merchants' Heat & Light Company, of Indianapolis, Ind., recently placed an order with the Westinghouse Machine Company for two 750-kw Westinghouse-Parsons turbine generating units to be installed as an addition to the present capacity of their power plant at Indianapolis. The new equipment will furnish light, heat and power throughout the commercial district of Indianapolis and the adjacent apartment residential district.

The Merchants' Heat & Light Company was organized in 1902 by the representative wholesale and retail merchants of the city for supplying electricity and exhaust steam to the districts above named. The plant which was erected for this purpose was started on the 1st of January, 1903, the initial installation consisting of 500 kw in engine type direct-connected units. Their business has grown so rapidly that during the winter of 1903-4 the electric plant was taxed to its utmost capacity, necessitating the provision of additional future capacity. During this period, the heating system was increased by approximately 200,000 sq. ft. of radiating surface, utilizing the exhaust steam from the engines.

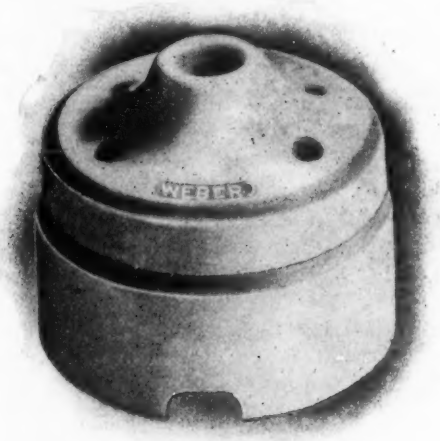
The present engine room occupies 2,500 sq. ft. and the building is being doubled to accommodate the present and future turbine equipment. The new addition will readily provide sufficient room for four 750-kw turbine units, so that the completed plant will have 3,000 kw capacity in turbine installation in the same space as the present engine equipment of 500 kw.

The turbines will discharge to the exhaust heating system throughout the winter months. During this period a back pressure of from 3 to 5 pounds will be carried and during extremely cold weather probably 8 pounds. With this back pressure the turbines will develop 20 per cent. in excess of their rated capacity. During warm weather the turbines will operate condensing upon a Worthington condensing system giving 27-in. vacuum referred to 30-in. barometer. Cooling towers will be employed.

The steam boiler plant is being extended to accommodate the new turbine equipment and when completed will aggregate about 4,220 hp in eleven units of Stirling & Wicks makes, the larger number being automatically fired by Roney mechanical stokers.

Improved Porcelain Rosettes.

Though one of the earliest electric lighting circuit appliances, the ceiling rosette has recently been found capable of decided improvement in construction. In a new type illustrated herewith, made by Henry D. Sears, 131 State Street, Boston, a very positive contract and a provision for locking are provided by a simple means. Contract is made on the under half of a piece of sturdy spring brass doubled at the portion projecting into the rosette. The end of the under portion is given such a shape that the contacts projecting from the cover securely lock when the cover is turned to its final position



ROSETTE.

—the cover contacts being shaped to fit the curvature given to the locking spring. The porcelain shells are so made that when the rosette is locked the two contacts are entirely separated by porcelain partitions. Another useful feature is that the covers for open and concealed work rosettes are interchangeable. It is claimed that with this rosette, which has been approved by the Fire Underwriters, short-circuiting is impossible, an extremely good contact is obtained, and there is no possibility of the cover becoming accidentally unlocked.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a stronger tone on the stock market for some of the standard stocks, due to the more satisfactory news regarding crop conditions. There was also some improvement in United States Steel securities. On the other hand, there were some weak spots in the market, notably Metropolitan Street Railway, which was effected by unfavorable reports as to earnings, and the prospective decline in its traffic when the subway is opened. These and other incidents had a quieting effect upon the general list toward the end of the week, but at its close, there was a firmer tone. Moderate support was extended to various specialties, including Brooklyn Rapid Transit and Amalgamated Copper. Less activity prevailed in the outside market, but values were fairly well maintained. Electric Boat was prominent in the list, common advancing about 12 points and preferred several points, on small transactions, with no particular reason for this sudden rise, other than the continued belief that there will be an increasing demand for submarine boats for war purposes. There was fairly active selling in the traction stocks, 1,135 shares of Brooklyn Rapid Transit having been traded in at prices ranging between 48¼ and 49¼, and 38,540 shares of Metropolitan Street Railway between 108½ and 111½, the former being also the closing price, ex-div. Brooklyn Rapid Transit closed at 48¾, being a net gain of ⅜. Allis-Chalmers common closed at 8½ and preferred at 41⅛, these figures representing gains of ½ and 1⅜ points, respectively. General Electric made a net gain of 1¾ points, closing at 154. Westinghouse fluctuated between 156 and 157, closing at 156½, which is a net advance of ½ point. Western Union closed at 87½, ex-div., and American Telephone & Telegraph at 130½, a gain of 1¼. Following are the closing quotations of June 28:

NEW YORK

	June 21	June 28		June 21	June 28
Allis-Chalmers Co.	8	8⅛	Electric Vehicle	9¼	9
Allis-Chalmers Co. pfd.	42	42⅛	Electric Vehicle pfd.	12	12
American Tel. & Cable	87	87	General Electric	151	154
American Tel. & Tel	130	129	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	110⅞	109¼
Brooklyn Rapid Transit	48¾	48⅛	N. Y. & N. J Tel.	..	..
Commercial Cable	175	175	Marconi Tel.	..	..
Electric Boat	32	43	Western Union Tel.	86⅛	86⅛
Electric Boat pfd	65	71	Westinghouse com	155¾	152
Electric Lead Reduction	*⅜	*⅜	Westinghouse pfd	175	180

BOSTON

	June 21	June 28		June 21	June 28
American Tel. & Tel.	13 ⅛	129¾	Western Tel. & Tel. pfd.	80	80
Cumberland Telephone	1 4¾	1.2¼	Mexican Telephone	1⅜	*1¼
Edison Elec. Illum.	234	239½	New England Telephone	119	*121
General Electric	..	153	Mass. Elec. Ry.	18	19
Western Tel. & Tel.	8	9	Mass. Elec Ry. pfd.	70¾	73

PHILADELPHIA.

	June 21	June 28		June 21	June 28
American Railways	44⅛	45⅛	Phila. Traction	96⅛	96⅛
Elec Storage Battery	54	54	Phila. Electric	6	6
Elec. Storage Battery pfd.	54	54	Phila. Rapid Trans.	11¾	11¼
Elec. Co. of America	8⅛	9			

CHICAGO

	June 21	June 28		June 21	June 28
Central Union Tel.	..	..	National Carbon pfd.	100	101
Chicago Edison	142	..	Metropolitan Elev. com.	18⅛	18⅛
Chicago City Ry.	*175	165	Union Traction	5	..
Chicago Tel. Co.	120	..	Union Traction pfd.	27	..
National Carbon	26¼	28⅛			

*Asked

BOSTON-PROVIDENCE TROLLEY.—It is stated that details of the high speed electric railway which is to run between Boston and Providence are being worked out by a local syndicate of street railway men with which James F. Shaw is identified. It is proposed to utilize the tracks of the Boston & Worcester Electric Company to Newton, and from there the line will run through Needham, Dover, Walpole, Wrentham, North Attleboro, Attleboro and Pawtucket to the city of Providence. Under the charter of the United Electric Traction Company of Providence, that company is obliged to build to the city limits to connect with any line entering the city, and this will make possible the entrance to that city. The plans call for the building of a total of 34 miles of track, a large proportion of which is to run over private rights of way. Where the highways are to be used the boulevard arrangement will be used with centre-pole construction. Large cars capable of high speed will be used and it is proposed to cover the 43 miles between Boston and Providence in a little over two hours. The cost of the line is estimated at $2,500,000, which will be provided for by an issue of stock of $1,250,000 and a bond issue of the same amount. The line will pass through sections of the State that have no direct street railway connection with Boston, and it is expected that a large way traffic will also be developed. The fare to be charged between Boston and Providence will be 50 cents, as compared with $1 on the steam roads.

TELEPHONY IN PHILADELPHIA.—The Bell Telephone Co., of Philadelphia, has reduced its pay station rate from 10 to 5 cents. It has also issued to its solicitors the following figures "obtained from a comparison of the May, 1904, issue of the Bell directory, with April 1904, issue of the Keystone directory":

Bell exclusives—	
Business	20,392
Residence	10,949
Physicians	1,413
	32,754
Keystone exclusives—	
Business	2,046
Residence	781
Physicians	22
	2,849
Total Bell exclusives	32,754
Total Keystone exclusives	2,849
Total number having both Bell and Keystone	6,580
Total number of names in Bell book	39,334
Total number of names in Keystone book	9,429

Up to this date there are 47,985 telephones in service in the city and 21,608 in the suburban system.

CONSOLIDATION AT ROCHESTER, N. Y.—A certification of consolidation of the Rochester Gas and Electric Company and the Rochester Light and Power Company, under the title of the Rochester Railway and Light Company, has been filed at Albany with the Secretary of State. The capital is $11,000,000, divided into 45,000 shares of preferred and 65,000 shares of common stock. The preferred stock is to bear 4 per cent. dividends for two years, and 5 per cent. thereafter. The directors are Frederick Cook, Alexander M. Lindsay, Edward Bausch, Albert O. Finn, G. A. Hollister, Thomas W. Finncone, George W. Archer, Henry A. Strong, Eugene H. Satterlie and Albert H. Harris, of Rochester; Henry D. Walbridge and Anton G. Hodenpyl, of New York City; Edward W. Clark, Jr., and Clarence M. Clark, of Philadelphia, and James Richardson, of Providence, R. I. Two actions have been started by minority stockholders to prevent by injunction proceedings this consolidation. It was alleged that the proposed issue of stocks and bonds of the consolidated company would be many millions of dollars in excess of the fair market value of the property, and that the corporation would be forced to earn large sums of money to pay the interest on the bonds and the dividends on the stock.

DIVIDENDS.—Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent., payable June 30. The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2½ per cent. upon the preferred and the assenting and the non-assenting stocks of the company, payable July 11. Books will close June 27 and reopen July 12. The directors of the E. W. Bliss Co. have declared the regular quarterly dividends of 2½ per cent. on the common stock and 2 per cent. on the preferred, payable July 1. Bell Telephone Company of Philadelphia directors have declared a regular quarterly dividend of 1½ per cent., payable July 15 to stock of record July 5. The Bell Telephone Company, of Missouri, has declared its regular quarterly dividend of 2 per cent., payable July 1. Union Switch & Signal Company directors declared the regular quarterly dividend of 2½ per cent. on the preferred stock and 2 per cent. on the common, payable July 11. The directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent., payable July 14. Books close June 30 and reopen July 15.

CONNECTICUT LIGHTING.—J. & W. Seligman & Co., of New York City, has notified the holders of the Connecticut Railway & Lighting Company's first and refunding 4½ per cent. fifty-year gold bonds that an agreement and supplemental mortgage dated June 23, 1904, has been executed between the United Gas Improvement Company, the Connecticut Railway & Lighting Company, and the Colonial Trust Company. Under the agreement the first agrees to guarantee by indorsement the interest on the bonds of the Railway & Lighting Company, of which $15,000,000 have been authorized and $10,269,000 are outstanding. The Connecticut Railway & Lighting Company agrees to establish for the benefit of the bonds so guaranteed a sinking fund of one-half of 1 per cent. per annum on the total amount of outstanding first and refunding bonds, in con-

sideration of an option to the United States Gas Improvement Company to purchase and an option to the Connecticut Railway & Lighting Company to call the bonds so guaranteed, on any coupon date, at 105 and interest.

NATIONAL GAS, ELECTRIC LIGHT & POWER.—In increasing its capital stock from $10,000 to $4,000,000 the amended articles of incorporation of the National Gas, Electric Light & Power Company state that the company's object is to buy, acquire, lease, construct, develop, improve, maintain, operate and deal in and with properties, rights and franchises for or connected with the production or distribution of light, heat or power by means of gas electricity or other agent. James T. Lyons is president and Frank K. Pelton is secretary. The papers appear to have been signed in Detroit, Mich. James T. Lynch hold three shares of the preferred, F. K. Pelton and Robert T. Gray one share each. Among the common stockholders are: Theo. H. Eaton, E. L. Kelsey, Dr. J. B. Book, A. L. Stephens, F. M. Osborne, Chas. W. Miller, E. T. Lynch, M. B. Dady, John D. McMahon, Ellwood T. Hance, A. D. Bennett and J. C. Duffield. The Corporation Trust Company, of Jersey City, is the local agent of the corporation.

ELECTRIC LIGHT EARNINGS.—The gross earnings for the Minneapolis General Electric Company for April were $47,466, as compared with $41,716 last year. The net shows a corresponding gain. The showing for the 12 months to April 30 is $586,212, as compared with $515,418 in 1902-3. The net for the year was $157,396, as compared with $122,647. The Lowell (Mass.) Electric Light Corporation shows gross for the 12 months ending April 30 $231,709, as compared with $224,113, and a corresponding gain in net. The Edison Electric Illuminating Company, of Brockton, Mass., showed for the 12 months gross of $109,107, as compared with $100,130; but the net was larger, being $32,247 against $18,262, after fixed charges in each case.

INTERNATIONAL STEAM PUMP.—The directors of the International Steam Pump Company have declared the regular quarterly dividends of 1½ per cent. on the preferred and 1 per cent. on the common. There was an impression that the dividend on the common stock would either be reduced or passed. When the common dividend was announced a year ago it was understood that the declaration of 4 per cent. for the year was made, payable in quarterly installments of 1 per cent. President Dunn says, however, that such was not the case, adding that the dividends have been declared as quarterly right along. The annual report is expected to show only a slight falling off in profits for the past fiscal year.

SOUTHERN NEW ENGLAND TELEPHONE.—The Southern New England Telephone Company reports an increase in gross earnings for 1903 of $178,977, in net earnings of $40,728 and in surplus after dividends of $14,013. The condensed balance sheet as of December 31 shows cash on hand of $2,991 and a profit and loss surplus of $82,746.

AMERICAN GRAPHOPHONE COMPANY has increased its capital stock from $3,000,000 to $5,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Better crop advices have given a stimulus to trade in the West where there is a better feeling. In the leading industries, however, there is no perceptible improvement. In the iron trade it would seem that the bottom had been reached so far as prices are concerned, and the curtailment of production is becoming widespread. Midsummer dullness pervades the principal textile industries, and manufacturers seem to have assumed a waiting attitude. The railway earnings so far in the month of June promise to make a better showing compared with the results of the earlier spring months. There is no improvement in collections, but it is thought that steady warm weather will bring with it better conditions for retail trade. Finished products in iron and steel are still dull in the eastern markets, but there is better inquiry for rails at Chicago, the Japanese Government, it is stated, having bought one lot. There is increased inquiry for hardware at western points, and prices for copper are rather more firm, with considerable activity in this metal. A large business was done for home trade and export, for spot as well as future delivery. The closing quotations are: 12⅜ to 12½ for Lake; 12¼ to 12⅜ for electrolytic and 12 to 12⅛ for casting stock. The ending of the strike among the lake shipmen has had a beneficial effect upon business, and ore is being moved down the lakes. The reports of trade along the Pacific coast are of a satisfactory character, due to better crop advices. In Boston there is more activity in dry goods, but in New York and Philadelphia there is complaint of dullness in the jobbing trade. Business failures for the week ending June 23 numbered 215, against 181 the week previous and 171 the same week last year.

ANOTHER GAS-ENGINE POWER PLANT FOR MEXICAN MINES.—The American-Mexico Company, whose headquarters are in Chicago, proposes to construct an extensive power plant at Velardena, State of Durango, Mexico, for the purpose of operating two big smelters which are to be constructed by the company and to drive machinery in the same concern's mine situated in that locality. Dr. A. T. Grove, the secretary of the company, has just returned from a trip to the southern republic, and it is expected that bids will be invited for the necessary equipment very shortly. The electric current will be generated by means of gas engines. The Power & Mining Machinery Company, of 52 William Street, New York (formerly the Loomis-Pettibone Gas Machinery Company of New York and successor to the Holthoff Machinery Company, of Cudahy, Wis.), recently secured a contract—the most important of its description heretofore awarded on this hemisphere—for a 3,000-hp plant consisting of Crossley gas engines and General Electric generators for the Velardena Mining & Smelting Company, which is controlled by the Guggenheim interests.

ANOTHER HUGE COPPER CABLE CONTRACT.—Another huge contract has just been let for copper cable. This time the material is for a Canadian concern, and a Montreal firm secured the order. There will be 1,500,000 pounds of copper used, which will represent an expenditure of about a quarter of a million dollars. The copper is for six cables to be strung on steel towers 40 ft. high and 400 ft. apart for the Toronto & Niagara Power Company's power transmission system. The contract has been allotted to the Dominion Wire Manufacturing Company. Mr. W. P. Plummer, Columbia Building, 29 Broadway, is the purchasing agent for the Toronto & Niagara Power Company. Mr. F. S. Pearson is the consulting engineer.

ANOTHER MEXICAN HYDRAULIC PLANT.—Mr. Frank Brennan, of Mexico City, has applied to the Mexican authorities for a concession which will permit of the utilization of the fall in the River Atoyac or Santa Maria Tepezintla, located in the district of Zacatlan, State of Puebla, Mexico. The point at which the power plant will be built is situated about nine miles distant from Zapotitlan. The fall from which power is to be derived is known as Cascada de Alpopoca. The franchise will grant the use of 1,500 liters of water per second. The energy is intended principally for lighting purposes.

NEW YORK TELEPHONE BUILDING.—The main office of the New York Telephone Company, at 13 to 17 Dey Street, is to be enlarged by the erection of a new fifteen-story addition at the side, 51. ft front and 89½ ft. deep. This will give a building with a frontage of 188 ft. The exchange at 14 Cortlandt Street is to be enlarged by the addition of a rear annex nine stories high and 24 ft. deep. The two improvements are to cost $467,000. The recent addition is said to be the tallest building of its width in the world. It has the proportions of a toothpick and ought to be so styled.

TROLLEY WORK IN BALTIMORE.—The Maryland Electric Railways Co. is again seeking the right to operate a street railway line in Baltimore city. An ordinance granting the company authority to lay tracks on streets in every section of the city has been introduced in the second branch of the city council, and referred to the committee on city passenger railways. It is stated that the passage of the ordinance would mean the expenditure of $6,000,000 to $8,000,000 in Baltimore for construction, street paving and other work.

EQUIPMENT FOR 60 WALL STREET.—It will be fully a fortnight before a definite decision will be arrived at regarding the equipment to be installed in the International Banking Company's building now under construction at 60 Wall Street through to Pine Street, New York. The equipment will, in all probability, be about 500-kw capacity. The report that the Ames Iron Works secured the engine contract is therefore premature. Clinton & Russell, the architects, of 32 Nassau Street, will award the contracts.

EQUIPMENT FOR NINETY-FIFTH STREET PUBLIC SCHOOL.—The electrical engineering firm of Peet, McAnerney & Powers, of 225 Fourth Avenue, New York, is the lowest bidder for the equipment to be installed in the public school under construction at Ninety-fifth Street and First Avenue. Their bid was $11,488.

TRADE IN NATAL.—Recent figures are interesting relative to the trade of Germany and the United States in the British colony of Natal, South Africa, for the year 1903. Electric fittings were: American, $30,000; German, $25,000; electrical machinery, American, $124,000; German, $75,000.

EQUIPMENT FOR NEW JERSEY LEAD PLANT.—The United Lead Company, of 71 Broadway, New York, is about to place orders for electrical equipment to be installed in its Perth Amboy (N. J.) plant. The engine will be of 200-hp capacity. There will be about 75-hp of motors.

J. G. WHITE COMBINATION TO BUILD LONDON HOTELS, ETC.—J. G. White & Company, Limited, of London, have formed a combination with the London firm of Waring & Gillow, Limited, one of the best-known decorating and furnishing concerns on the other side, for the purpose of carrying out important contracts for the construction and furnishing of large hotels, office buildings, etc., in England, a number of which contracts have already been secured. A company, styled the Waring-White Building Company, Limited, has been incorporated under the British Limited Liability Act, with a capital of £100,000 to carry out these contracts. Messrs. J. G. White and J. B. White are directors. The managing director is Mr. R. A. Dunnell, formerly head of the building department of the D. H. Burnham Company, architectural engineers, Chicago, Ill. Mr. A. H. Beatty, secretary of J. G. White & Company, Limited, also acts in a similar capacity to the Waring-White Company. Among the contracts in hand is one for the new Hotel Ritz in London. The new company will also construct the London office building of the International Mercantile Marine Company.

BLAKE & KNOWLES PUMP CONTRACT.—The Blake & Knowles Steam Pump Company, Limited, of London, which concern is the British end of the Blake & Knowles branches of the International Steam Pump Company, 114 Liberty Street, New York, has secured the substantial contract for the surface condenser and pumping equipment to be installed in the municipal electric lighting plant at Aberdeen, Scotland. The International Steam Pump Company—Blake division—has been recently allotted several contracts for marine equipments. The U. S. torpedo boat destroyers, Dale and Decatur, now at Manila, will be equipped with Blake distiller circulating and evaporator feed pumps. The Spanish gunboat Isla de Luzon, which was sunk in Manila during the sea fight, has been raised and is now lying at the Pensacola Navy Yard, where she will be refitted for use in the service of the U. S. Navy. The English pumps originally installed will be displaced by Blake outfits, consisting of feed, fire, bilge, fresh and salt water pumps.

SOME C. & C. ORDERS.—The C. & C. Electric Company, New York, has secured a contract for a 50-kw generator and switchboard for the St. Charles (Ill.) Home for Boys. The engine will be built by A. L. Ide & Sons, of Springfield, Ill. A 25-kw generator to be direct-connected to an Ide engine has been ordered by the Bedford (Ind.) Quarries Company. This is a repeat order. Another repeat order has been secured for a 40-hp series parallel equipment for the Binghamton (N. Y.) *Press*. This equipment will be utilized to drive a Hoe quadruple press. Eight double commutator variable speed motors, varying in capacity from 3-hp to 7-hp, have been ordered for driving machinery tools in the Brooklyn Navy Yard. These motors will be equipped with Cutler-Hammer controllers. Two 30-hp C. & C. motors have been requisitioned for driving blowers in the new uptown store of Tiffany & Company.

EXPORTS OF ELECTRICAL MACHINERY TO JAPAN.—A statement issued by the Bureau of Statistics of the Department of Commerce and Labor shows that the exports of electrical machinery to Japan for the 11 months ending May 31, 1904, were valued at $715,057, as compared with $426,562 for the corresponding period of last year. The exports of scientific instruments for the same periods decreased from $255,833 in 1903 to $131,605 in 1904. Increases are shown in other articles, cars and carriages from $133,402 to $250,446; builders' hardware, from $129,449 to $148,133; locomotives, from $275,042 to $499,073; typewriters, $14,357 to $21,042, and a substantial increase in most other articles is noted. The war does not seem to have had any appreciable effect on Japan's demand for modern things.

WESTON-CUTTER SELLING AGREEMENT.—A report is in circulation, as we go to press, and which is apparently well founded, that an agreement, based primarily on a three-year term, has been entered into between the Weston Electrical Instrument Company, of Newark, N. J., and the Cutter Company, of Philadelphia, whereby the latter undertakes to handle and sell the well-known Weston central station instruments. As a result of this "deal," it is rumored, the Boston and Pittsburg offices of the two concerns will be worked in joint arrangement, while probably some changes will occur in New York. It is naturally supposed that this important step is the outcome of the recent litigation over the Keystone instruments, which the Cutter people have been handling up to this time.

ELECTRICALLY DRIVEN PUMPS FOR MEXICO.—Mr. Manuel Cuevas, who has extensive water concessions in the State of Jalisco, Mexico, is making arrangements to begin construction work, according to advices just to hand from the southern republic. The concessions permit of the utilization of water from Lake Chapela sufficient to irrigate 300,000 acres of land and to use water from the Santiago River between the Juanacatlan Falls and Poncitlan, also for irrigation. The concessionaire proposes to build canals from the lake to the river in a northerly direction and to use pumps at the lake in order to raise the water to the canals. The pumps are to be electrically operated, power being supplied from a plant to be built on the Santiago River.

PUEBLA LIGHTING CONTRACT.—The City Council of Puebla, one of the principal cities in Mexico, has extended the contract with the Compania Anonima del Alumbrado Electrico for furnishing energy to light the city for a period of 25 years, on condition that the capacity of the plant be increased and the free service of 200 arc lights be established. The company operates a water power plant of about 500-hp capacity. The engines are of McIntosh-Seymour build. The water wheels were built by James Leffel & Company, of Springfield, O. Mr. H. S. Wilson is superintendent and chief engineer of the plant.

MORE LIGHTING EQUIPMENT FOR HOTEL CADILLAC.—The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, has secured a contract for two 125-hp engines and one of 75-hp capacity for installation in the Hotel Cadillac, Broadway and Forty-third Street, New York. The engines will be built by the Harrisburg Foundry & Machine Works. They will be direct-connected to 75-kw and 50-kw generators of General Electric Company make. The equipment will be used for additional lighting purposes.

ELECTRICALLY OPERATED PUMPS FOR HAWAII.—Mr. George H. Baldwin, engineer in charge of the construction of the Hamahaua Ditch, Huelo, Hawaiian Islands, will soon place contracts for electrically operated, high-lift, irrigation pumping equipments. The broad conditions to be met are: Power head about 200 ft.; pump lift, 600 ft. or so; length of transmission line, ½-mile to 4 miles; length of discharge pipe, 1 mile to 3 miles, while the quantity of water to be raised will vary from 500,000 to 5,000,000 gallons per day.

LONG-DISTANCE TELEPHONE FOR CHIHUAHUA.—Mexican advices state that the syndicate which is being formed to construct a system of electric railways in the city and district of Parral, State of Chihuahua, proposes also to build and operate an extensive long-distance telephone system in the same State connecting all the principal mining camps and agricultural and cattle regions with the capital of the State. Mr. Lorenzo J. Arellano, of Chihuahua, is primarily interested in the scheme.

ARGENTINE GOVERNMENT WANTS CATALOGUES, ETC.—The Argentine Government is desirous of securing descriptive catalogues, price lists, etc., relating to electrical equipment, etc., for navy yard use, particularly including dynamos for driving lighting plants, flash lights and steam turbines, suitable for naval purposes. The catalogues, etc., should be forwarded to Lieutenant Luis A. Lan, naval attache to the Argentine Legation, Washington, D. C.

THE ALBERGER CONDENSER FOR MASSACHUSETTS PLANT.—The Alberger Condenser Company, New York, has secured the contract for the condensing outfit to be installed in the additional plant of the Boston & Worcester Street Railway at Framingham, Mass. The equipment will consist of a surface counter current condenser to take care of the 200-kw Curtis turbine to be put in. There will also be three cooling towers.

EQUIPMENT FOR P. R. R. GREENVILLE YARDS.—Considerable electrical equipment is about to be ordered for installation in the terminal yards of the Pennsylvania Railroad Company at Greenville, L. I. The equipment, which will be utilized for both light and power purposes, will be capable of developing 1,500-hp. Mr. H. H. Maxfield, assistant engineer of the motive department of the Pennsylvania Railroad, has the matter in hand.

THE CANADIAN WESTINGHOUSE COMPANY, LTD., of Hamilton, Ontario, has recently closed a contract to furnish the Shawinigan Water & Power Company, Shawinigan Falls, P. Q., with a 6600-kw two-phase, 2200-volt, 30-cycle, 180-r.p.m. rotating field alternator, for direct connection with water wheel. Two 2200-kw, oil-insulated water-cooled transformers, 2200 volts primary, 50,000 volts secondary, are included in this contract.

MEXICAN LIGHTING SCHEME.—Mexican advices state that the owners of the Jaupa cotton mills are arranging to furnish the City of Tepic, Territory of Tepic, with current to light that place, which has a population of some 15,000 people. Considerable new generating equipment will be purchased.

OUTFIT FOR MAINE COPPER MINES.—The Bluehill Copper Mining Company, of 52 Broadway, New York, Mr. G. M. Irvin, president, is to equip its Maine property with a 200-hp engine and a generator of 120-kw capacity.

MEXICAN WATER POWER PROJECT.—Mexican advices state that a fair-sized water power plant is to be constructed shortly at the Mina de Oro property, owned by a syndicate of which Mr. Robert J. Kerr, of Mexico City, is the leading spirit.

MORE EQUIPMENT FOR TIMES BUILDING.—Contracts are about to be let for additional electrical equipment to be installed in the New York Times Building, Park Row. Pattison Bros., Flatiron Building, are acting as electrical engineers in the matter.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, St. Louis, Sept. 12-17, 1904.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 93 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting St. Louis, Mo., Oct. 12 and 13, 1904.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore. Next meeting, New Castle, N. H., Aug. 30 and 31 and Sept. 1, 1904.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Chattanooga, Tenn., third Wednesday in May, 1905.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Montreal, 1905.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Colorado Springs, Sept. 21, 22 and 23, 1904.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, D. Fleming, Harrisburg, Pa. Next meeting, New York City, December, 1904.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y. Next meeting, Utica, July 19, 1904.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, LaSalle, Ill.

INDIANA PUBLIC UTILITIES ASSOCIATION. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Pichardt, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, St. Louis, Sept. 13 and 14, 1904.

INTERNATIONAL ELECTRICAL CONGRESS. General secretary, Dr. A. E. Kennelly, Cambridge, Mass. Meeting, St. Louis, Sept. 12-17, 1904.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April, 1905.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia. Next meeting, second Tuesday in March, 1905.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ind.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Dudley Farrand, Newark, N. J.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept., 1904.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Sandusky, Ohio, Aug. 16, 17 and 18, 1904.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, Canton, Ohio. Next meeting, Canton, Nov. 18, 1904.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next annual meeting June 21, 1904.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, F. E. Scovill, Austin, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, Sept. 21 and 22, 1904.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—Mr. H. F. Robinson, city engineer, informs us that a new independent telephone system is being established there at a cost of not less than $50,000.

SONOMA, CAL.—Bids will be received by J. B. Small, City Clerk, until August 3, for a telephone franchise as applied for by Louis Breitenbach.

SANTA ROSA, CAL.—The Mark West Creek & Santa Rosa Telephone Company has been incorporated with a capital stock of $15,000. The directors are R. W. Peterson, J. L. Peterson and others.

SAN FRANCISCO, CAL.—The Pacific Telephone Company's lines, in Mendocino County, Cal., are to be extended from Laytonville to Sherwood, connecting with the new terminal of the California & Northwestern Railroad and meeting the Pacific States Telephone Company's lines at Willitts.

ROME, GA.—The telephone system of Rome was damaged recently to the extent of $500, and 200 telephones were put out of business by contact with a trolley wire.

ATLANTA, GA.—The returns of the Southern Bell Telephone Company, accepted recently by the Comptroller General of Georgia, show an increase in valuation of $150,263 over last year, $116,910, being on the tangible property and the remainder on the franchise.

CHICAGO, ILL.—The Chicago Bell Telephone system gained 1556 instruments in May, making 108,884 in use.

CHICAGO, ILL.—The Telephone Transmitter Guard Company has been incorporated with a capital stock of $10,000. The incorporators are J. H. Kaft, R. D. Famion and others.

TEMPLE HILL, ILL.—The Egyptian Mutual Telephone Company has been incorporated with a capital stock of $2500. The incorporators are William C. Holmes, H. M. Stoles and others.

WILLIAMSVILLE, ILL.—The Williamsville & Sherman Telephone Company has been incorporated with a capital stock of $25,000. The directors are S. T. Jones, C. M. Woods and others.

MUNCIE, IND.—The Delaware and Madison Counties Telephone Company is stringing nearly a hundred miles of wire from its three principal exchanges out into the farming communities.

SCIRCLEVILLE, IND.—The Scircleville Telephone Company has filed articles of incorporation. The capital stock is $6000.

URBANA, IND.—The Urbana Independent Telephone Company has been incorporated with a capital stock of $10,000. The directors are E. Staver, E. F. Baker and others.

VEVAY, IND.—The Farmers' Mutual Telephone Company, of Switzerland County, has filed articles of incorporation. The capital stock is $5000. J. D. Forman, H. Wales and Robert Flatten are directors.

WILMOTT, IND.—The Wilmott Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. The company purposes to build an exchange in Wilmott and extend the lines throughout a portion of Whitley County. J. W. C. Scott is president and Franklin Hunt secretary.

COUNCIL BLUFFS, IA.—A new telephone company is being organized here by C. A. Beno, F. J. Day and others.

PORTLAND, ME.—The Zenith Telephone Company has been organized at Augusta, the capital stock being $1,000,000. The officers are: President, M. H. Simmons; treasurer, E. F. Whittum, of Augusta.

ACARACHERO, MEX.—A telephone line has been built between this place and Nocupetaro.

CULIACAN, MEX.—The state government of Sinaloa has prepared plans for the construction of an extensive system of telephone lines in this State. The plans contemplate giving the State of Sinaloa more miles of telephone than any other state in Mexico.

WATERTOWN, MINN.—The Dakota Central Telephone Company contemplates erecting a $10,000 building in this city this summer.

ST. PETER, MINN.—The Farmers' Co-operative Telephone Company has been incorporated with a capital stock of $12,000. J. H. Nutter is president.

ST. LOUIS, MO.—The Missouri Medical College Building, located at the corner of Twenty-second Street and Lucas Avenue, has been sold to the Missouri Telephone Company for $18,000. The building, while massive and substantial, has outlived its usefulness as a medical college, and has long since been abandoned for that purpose. It is located, however, in a district that is becoming popular for factories. Extensive alterations will be made by the telephone company, and it will be used as the headquarters for the telephone business.

CHESTER, N. Y.—The Chester Telephone Company has been incorporated with a capital stock of $2000. The directors are G. M. Roe, T. F. Lawrence and others.

MIDDLETOWN, N. Y.—At a meeting of the stockholders of the Wawayanda Telephone Company it was decided to sell the plant to the Hudson River Telephone Company.

JAMESTOWN, N. Y.—A new telephone system is to be built through the Conewango Valley by a company which has been incorporated by E. B. Crissey, D. C. Wilson and others.

NORTH WALCOTT, N. Y.—The Farmers' Co-operative Telephone Company, of this place, has been incorporated, the capital stock being $500. The directors are Robert Brundidge, Benjamin Brundidge and Sylvester Brundidge, of Wolcott.

HAMMONDSPORT, N. Y.—The Hammondsport Rural Telephone Association has just been formed by the several rural telephone lines centering at this place. Officers have been elected as follows: President, Robrt Sherer; manager, Maurice A. Hoyt.

BINGHAMTON, N. Y.—The Chenango-Broome Telephone Company has been incorporated to operate in Broome and Chenango counties. The capital stock of the company is $700, and the headquarters are at Greene. The directors are Eugene Watrous, of North Colesville, and C. C. Allen and J. D. Van Valkenburg, of Greene.

AUSTINBURG, OHIO.—A new telephone company is being organized here with Dr. Houghteling as president.

COLUMBUS, OHIO.—The Citizens' Telephone Company, of this city, is preparing to erect a new building in this city.

PHILLIPSBURG, OHIO.—The Acme Telephone Company has increased its capital stock from $8000 to $15,000.

HAMILTON, OHIO.—The Cincinnati & Suburban Bell Telephone Company has enjoined the village of Oxford from removing its poles in that village.

URBANA, OHIO.—The Urbana Independent Telephone Company has been organized by Adam Cook, George Pretorius, J. C. Schmalzreid and others. Capital stock $10,000.

TOLEDO, OHIO.—The Toledo Home Telephone Company has expended $150,000 in extensions and improvements, this amount having been paid out of the earnings and not from sale of treasury bonds.

PIQUA, OHIO.—Representatives of 25 independent telephone companies met here last week and formed the Miami Valley Telephone Association. A committee on permanent organization was appointed and another meeting will be held July 1.

ASHLAND, OHIO.—The village has applied for an injunction to restrain the Central Union Telephone Company from building a telephone system in that place. It is claimed that the franchise granted some time ago required that the system be installed by April, 1904.

CINCINNATI, OHIO.—It is stated that the Queen City Telephone Company will begin work on its new local system in thirty days. It is estimated that the new plant will cost about $3,000,000. A building will be erected, which will ultimately provide for an exchange of 100,000 subscribers.

CLEVELAND, OHIO.—The Cleveland Telephone Company, at its recent annual meeting, elected directors and they in turn elected officers as follows: President, Frederick P. Fish; vice-president, Hemart J. Pettengill; general manager, P. Yensen; secretary, Charles A. Grant; treasurer, James P. McKinstry; assistant treasurer, John Balch.

COLUMBUS, OHIO.—The State Supreme Court has decided that the City of Findlay cannot prevent the Home Telephone Company from raising its rates. The decision was rendered in the case of a subscriber who refused to pay more than the rate fixed in the ordinance, namely, $12 per annum. In delivering the opinion, Judge Day, of the Circuit Court, said that the city had no more right to fix telephone charges than it has to fix the price of groceries, dry goods, or other life commodities. This opinion has been affirmed by the Supreme Court.

INDEPENDENCE, OKLA.—The Deer Creek Mutual Telephone Company, with a capital stock of $50,000, has been incorporated by W. R. Cooper, J. W. Grigsby, Chas. Patterson, J. M. Nelson and C. M. Collins, of Independence, and J. M. Nelson, of Seven Oaks.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, has reduced its tolls in ten suburban pay station districts from 10c. to 5c. The districts affected are being covered by the Keystone Telephone Company, which charges a flat rate of 5c. for pay station calls.

CHARLESTON, S. C.—The charter of the Charleston & Sea Island Telephone Company has been filed, the capital being $15,000. This company succeeds a former organization operated in connection with the Gordon system.

JONESBORO, TENN.—The Automatic Home Telephone Company, of Jonesboro, has been incorporated with a capital stock of $25,000, of which $3000 has been subscribed. The directors are R. L. Collins, president; F. C. Watte, vice-president; A. C. Gambill, secretary, and R. L. Jones, treasurer.

BEAUMONT, TEX.—The Southwestern Telegraph & Telephone Company will make extensive improvements to its Beaumont telephone system.

WAXAHACHIE, TEX.—The Mutual Telephone Company has been incorporated with a capital stock of $5000. The directors are W. A. Lewis, W. A. Culberson and others.

UNION BLUFF, TEX.—The Union Bluff Telephone Company has been incorporated with a capital stock of $250. The directors are G. H. Garrett, J. T. Daniels and others.

TACOMA, WASH.—The Mortimer Telephone Company has petitioned the city council for a franchise for a telephone system and messenger service.

TACOMA, WASH.—The Steamship *Burnside* is loading 650 miles of submarine cable at Tacoma, where about 900 miles of cable are stored. An additional shipment of 700 miles of cable is being made by rail from the East, which will also be used in the completion of the Government cable from Alaska to Puget Sound.

WHEELING, W. VA.—The Baltimore & Ohio Railroad Company has just completed the work of installing a complete telephone system in Benwood for the transaction of its own business.

RACINE, WIS.—The Citizens' Telephone Company has purchased a site and will erect a central exchange building in this city.

QUEENSTOWN, WIS.—The town council contemplates putting up a plant for telephone and water works service. The estimated cost is nearly $350,000.

RED BANK, WYO.—The Red Bank Telephone Company has been incorporated with a capital stock of $20,000.

TORONTO, ONT.—Two telephone companies have made application to the board of civic control of the city of Toronto for permission to install a telephone system in the city to compete with the Bell telephone. The Bell has offered to enter into a five-year agreement, and to give some concessions. The board decided to call for offers for a competitive system.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The Mutual Electric Light Company, of San Francisco, has broken ground at the site of its new electric generating station at the corner of Spear and Folsom Streets. Two 1500-kw Bullock polyphase generators are on hand and will be direct connected to two Pennsylvania Iron Works horizontal engines. The boiler contracts will be let soon in order to have the new plant installed in time to help out the old station with the "peak" load of next winter.

SAN FRANCISCO, CAL.—John B. Irish, a Downieville attorney, recently filed notices in Marysville, Cal., of water right locations on the north fork of the Yuba River, claiming 15,000 inches for power and agriculture use. He represents the Marysville & Susanville Railway Company, which has been incorporated to construct an electric railway from Marysville to Susanville. Preliminary surveys are going on in Plumas and Sierra counties. According to the location notices, it is the intention to develop electric power in Yuba County at points near the mouth of Slate Creek and also at Bullard's Bar.

NORFOLK, CONN.—The Norfolk Electric Light & Power Company is to be reorganized. The company has not been giving any service for two months.

OCILLA, GA.—It is proposed to construct an electric light plant here.

LAGRANGE, GA.—An election will probably soon be held to vote on issuing bonds for an electric light plant.

THOMSON, GA.—The citizens have voted to issue $25,000 in bonds for water works and an electric light plant.

MOSCOW, IDAHO.—Work has begun on the new transmission line of the Lewiston Water Power Company, which will transmit 500-kw from Asotin to Genessee, Uniontown, Pullman and Moscow, and it is expected to get the power in Genessee by Sept. 1 and to Moscow by Oct. 1, 1904. The Moscow Electric Light & Power Company has secured a ten-year contract from the city of Genessee for lighting the streets and pumping the city water; also the Wood flour mills have contracted for electric power to run their large mills. The Moscow company has a contract with the Lewiston company to distribute the power in all territory north of the Clearwater River in Idaho and Washington. At present about 60 miles of line will be built distributing at 22,000 volts.

CARROLLTON, ILL.—The Carrollton Heat, Light & Power Company has been incorporated, with a capital of $5000. Incorporators: Robert H. Bigger, F. M. Sinsabough and W. D. Moore.

MUNCIE, IND.—The entire holdings of the Muncie Electric Light & Steam Heating Company have been purchased by the Electric Light Company of America.

RICHMOND, IND.—The annual report of the Municipal Electric Light Commission for the fiscal year ending May 31, has been filed with the City Council. The net loss of the plant for the year was $8,288.96, not including interest on bonds or depreciation. The expenditures include the amount paid out for new construction, $15,246.39. Without this item the plant earned $6,957.43, not including depreciation and interest. The total receipts were $40,175.44 and the total expenditures $40,964.40.

SIOUX RAPIDS, IA.—A committee has been appointed to secure the lowest price on the present electric light plant and also to learn the expense of putting in an entirely new one. W. J. Pulford and J. H. McCord are on the committee.

HAWARDEN, IA.—It is reported that the electric light plant will be repaired at a cost of $6000.

HUTCHINSON, KAN.—The City Council has recommended the construction of an electric light plant. S. F. Johnson is City Clerk.

CONCORDIA, KAN.—The City Council has granted O'Reilly & Dougherty, of Concordia, a 10-year franchise for lighting the city with electric lights.

COVINGTON, KY.—The litigation involving the construction of a municipal light plant has been decided in the U. S. Court of Appeals in favor of the City of Covington. An issue of $75,000 in bonds is authorized for its construction. No plans have been prepared. Address all communications to Geo. Beach, mayor.

KITTERY, ME.—The Arcadia Light Company has been incorporated with a capital stock of $100,000. E. L. Cheany is president and J. E. Forsythe, treasurer, both of Kittery.

SEARSPORT, ME.—The Searsport Electric Light Company has been organized to manufacture gas and electricity in Searsport, with $10,000 capital stock. Harry L. Cram and A. J. Desmond, both of Portland, are the incorporators.

ROCKVILLE, MD.—The council has decided to employ an engineer to prepare estimates for rebuilding or repairing the electric light plant which was burned several years ago.

SUNDERLAND, MASS.—The Sunderland Electric Light & Power Company will erect and equip a power house in North Sunderland.

BOSTON, MASS.—Bids will be received July 9 by Mordecai T. Endicott, Chairman of Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing two 750-kw steam turbo-generator units at the Charlestown Navy Yard.

DULUTH, MINN.—It is reported that arrangements have been made for the development of the water power of the St. Louis River. The contracts for equipment have not yet been made. Mr. C. A. Duncan, president, and C. C. Cokefair, general manager of the Great Northern Power Company, are interested in this enterprise.

MISSOULA, MONT.—The Missoula Light & Power Company and the Missoula Water Company, of this city, have consolidated under the title of the Missoula Light & Water Company.

ST. LOUIS, MO.—The Suburban Electric Light & Power Company of Webster Grove, St. Louis County, has filed a petition for a franchise to extend its lines over the county.

SAGINAW, MICH.—W. A. Markey, of Saginaw, has been selected by the city engineer to assist in preparing plans for a municipal electric light plant.

ATWATER, MINN.—The citizens have voted to construct water works and an electric light plant. O. H. Larson is village recorder.

STILLWATER, MINN.—It is reported that the Stillwater Gas & Electric Company will erect a new power station here.

PLATTSMOUTH, NEB.—The Plattsmouth Gas & Electric light plant was sold at public auction June 6 to the New Hampshire Bank Company for $13,334. The sale was to satisfy a mortgage against the plant for about $22,709. Private parties are talking of putting in a new plant.

NEW YORK, N. Y.—Bids will be received July 5 by Wm. McAdoo, Police Commisioner, for furnishing material and placing electrical conductors underground.

WATKINS, N. Y.—Bids will be received until July 20 by the Board of Water and Sewer Commissioners for $20,000 electric light bonds. C. M. Woodward is secretary.

NEW YORK, N. Y.—Plans have been filed for the construction of a 3-story brick and concrete power-house at 609 W. 39th Street, at a cost of $60,000 for the New York Butchers' Dressed Meat Company. Horgan & Slattery are the architects.

MT. OLIVE, N. C.—Bids are wanted July 1 for constructing an electric light plant. X. T. Keel may be addressed.

CINCINNATI, OHIO.—The Cincinnati Gas & Electric Company has closed a contract with the Westinghouse Elec. & Mfg. Company for a 1000-kw motor-generator, and one with the General Electric Company for 50,000 feet of underground feeder-cable. The Standard Underground Cable Company was also given a contract for 100,000 feet of overhead conductor.

LA GRANDE, ORE.—The La Grande Light & Power Company has sold its entire holdings to gentlemen of Dayton, Wash., and in the future the company will be known as the Thronson Stock & Land Company. Mr. J. A. Thronson is president and C. J. Thronson, treasurer.

BUFFALO HUMP, ORE.—The Jumbo Company is contemplating adding new motors and other machinery in order to enable it to treat all of the ores milled at its property. Mr. Frank Brown is manager.

NEWPORT, PA.—The Perry Electric Company's plant and franchise have been purchased by the Juniata Electric Company of this place, the price paid for the property being $26,000.

CHARLESTON, S. C.—At the annual meeting of the Charleston Light & Water Company, directors were elected for the following year, and officers were then chosen with A. H. Post, president, and Zimmerman Davis, secretary and treasurer.

CHATTANOOGA, TENN.—The report of the committee appointed to investigate the feasibility of the city undertaking the construction of the lock and dam for power purposes has been adopted by the city council. The recommendations provide for furnishing to the city free of charge sufficient power to supply 500 arc lamps for a term of 15 years, and the city reserves the right to buy the power plant at the end of 50 years at the cost of construction.

McKINNEY, TEX.—The citizens have voted to issue $8,000 in bonds for the construction of an electric light plant.

DALLAS, TEX.—The Dallas Light & Power Company has completed plans for the immediate erection, in this city, of a power plant to cost, when completed, about $500,000. The old steam engines now in use will be replaced by steam turbines.

SALT LAKE CITY, UTAH.—Bids will be received by the Supervising Architect, Treasury Department, Washington, D. C., on July 26, for the installation of a conduit and electric wiring system for the U. S. Court House and Post Office at Salt Lake City.

ELMA, WASH.—The Council is considering the electric light question, and whether to grant a franchise or construct a municipal plant.

SEATTLE, WASH.—The Puyallup Light & Power Company will spend about $200,000 on improvements.

OSHKOSH, WIS.—It is proposed to sell the property of the Oshkosh Electric Light & Power Company. The concern has been in the hands of the receiver about a year.

NANAIMO, B. C.—The electric light company of this place will erect a new power house to supersede the present plant. Contracts aggregating $15,000 have been let.

HAMILTON, ONT.—The city of Hamilton is endeavoring to get cheaper street lighting. It now pays $85 a lamp per year, which is the highest price paid in any city in the Dominion. A clause in the present contract specifies that at the end of August next, if it can be shown that the cost of producing light has been reduced since the signing of the contract, five years ago, then the city will be entitled to a reduction in the price of street lighting. The city engineer figures that the cost has been reduced at least $15 per lamp by the new enclosed arc lamps alone.

OTTAWA, ONT.—The Canada Electric Company applied to the Quebec Legislature, at is recent session, for a bill giving it similar powers to those enjoyed by the Montreal Light, Heat & Power Company. That is, it desires the right to enter Montreal streets and do business under the direction of the city authorities without first having to secure permission of the city council. The bill was passed, however, with some amendments which considerably reduced its scope. One amendment authorizes the company to do business in municipalities only after obtaining a special permission by-law from such municipalities. The result of this is that in order to enter into the field in Montreal, the company must first secure a by-law from the city permitting the company to use the city streets for its purposes, and carefully defining and delineating its powers.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—The franchise recently granted by the Secretary of the Interior for an electric railway into the Yosemite National Park, is said to be the first franchise of the kind ever given by the Government in any State. F. G. Drum, Captain Ward and several San Jose capitalists signed the petition for the franchise, which authorizes the construction of an electric road extending from Merced to the Merced River and following the river into the Yosemite Valley. Work on the line is to be commenced this summer, and stations are to be located at intervals of ten miles. The running time from Merced to the Park will be between five and six hours. W. C. Ray is the promoter and F. G. Drum is the financial representative of W. S. Tevis, a San Francisco capitalist, who is interested in the California Gas & Electric Corporation.

LOS ANGELES, CAL.—The Los Angeles Pacific Railway is arranging for the opening of the extension of the system between Ocean Park and Playa del Rey by July 4. This will give the company a double-track line from Los Angeles to Santa Monica, Ocean Park, Playa del Rey and Redondo. To meet the increased demands on this system for equipment, E. P. Clarke is now in the East arranging for the immediate shipment of many new cars. The equipment will be distributed at first on the Hermosa Beach, Manhattan Beach and Redondo extensions, as the greatest demand is from the patrons of the road in these localities. The Hollywood and Santa Monica lines will also be given their proportion. The company's new power house at Vineyard will be ready for work in sixty days; this will give more power for the Playa del Rey and Santa Monica lines.

NEVADA CITY, CAL.—George F. Taylor, a civil engineer at Downieville, is in the field with a corps of assistants, and has begun a preliminary survey of the route for the proposed electric railway from Marysville to Sierra County. The route will follow the river.

OAKLAND, CAL.—The capacity of the line storage battery in the power house of the Key Route has been increased by 50 per cent., raising the output to 1500-amp.-hours on a one-hour discharge rate. The addition was made by the Electric Storage Battery Company.

HARTFORD, CONN.—A certificate of incorporation has been filed by the Penobscot Central Railroad Company, of this city, which will build, own and operate railroads and street railways in the State of Maine, and will hold securities of the Penobscot Central Railway Company, of Bangor, Me. The Penobscot Central Railroad Company is a trolley line for the carriage of passengers and freight. It runs for 23 mile from Bangor to Charleston, Me. The authorized capital stock of the new company is $2000, and the business will be begun with $1000. The incorporators are William H. Newton, a Wallingford bank official, who holds twenty shares; P. J. Cronan, of this city, capitalist, who holds nineteen shares, and S. C. Morehouse, an attorney, who holds one share.

WILMINGTON, DEL.—The West Chester, Kennett & Wilmington Elec-Railway Company is preparing estimates and plans for a number of extensive improvements.

ATHENS, GA.—A movement is on foot among local capitalists looking to the construction of an electric railway from Athens to Jefferson, a distance of 16 miles.

ALTON, ILL.—The Alton Light & Traction Company, with $1,000,000 capital, has been merged into the Alton, Granite & St. Louis Traction Company, with $3,000,000 capital. The merger is part of the plan for the Alton Company to build the electric railway between Alton and St. Louis, now in course of construction.

CHICAGO, ILL.—The South Side Suburban Railway Company has filed its application for an ordinance in the City Council and the same is now under consideration in the hands of the transportation committee. The territory is at present without adequate transportation facilities. That part of the territory in the Calumet region has industries employing about 15,000 men. The industrial centers of Pullman, West Pullman, Dalton, Hammond, Harvey and Chicago Heights will be placed in direct communication by means of this road.

MOORESVILLE, IND.—The Indianapolis & Martinsville Rapid Transit Company has received a franchise for electric lighting from the city council. The company's power house is situated here.

PRINCETON, IND.—The Evansville & Princeton Traction Company is contemplating improvements in the service which will furnish an urban as well as suburban system of transportation for this city.

INDIANAPOLIS, IND.—The Angola Electric Railway & Power Company has filed articles of incorporation with the Secretary of State. The capital stock is $100,000. The directors are Henry C. Paul, M. B. Kelley, Samuel Foster, W. J. Vessay and others.

MUSKOGEE, I. T.—The Muskogee Electric Street Railway Company has been incorporated for $100,000, and members of the company have gone to Chicago to make preparations for beginning the construction.

CLINTON, IA.—The Iowa & Illinois Interurban Railway Company has awarded the Westinghouse Company a contract for a turbo-generator set for its power station.

FRANKFORT, KY.—The Eminence & Newcastle Electric Railway Company of Henry County has been incorporated with $150,000 capital stock. G. W. Young, Newton Bright and L. H. Lebur, of Eminence, and W. L. Nuttall, of Newcastle, are incorporators.

NORTH ADAMS, MASS.—The Hoosac Valley Street Railway Company has petitioned the Railroad Commission for authority to issue additional capital stock of $100,000 and additional bonds of $400,000.

WORCESTER, MASS.—The Superior Court has discharged John A. Hall and Charles M. Thayer from their receivership of the Worcester & Southbridge Street Railway Company and of the Worcester, Rochdale & Charlton Depot Street Railway Company, the affairs of the roads having been wound up.

ROCKLAND, MASS.—Preliminary surveys are now being made by the Plymouth County Street Railway Company for the construction of an electric railway from Rockland to Brant Rock, Duxbury and Kingston. The new road will open up an entirely new country. The officers are C. F. Remington, president; Cass Levey, treasurer; George E. Morgan, general manager.

MIDDLEBORO, MASS.—By an agreement with the New Bedford & Onset Bay Street Railway Company to furnish power, the Middleboro, Wareham & Buzzards' Bay Street Railway Company has been able to resume operations. The latter road was recently placed in the hands of receivers. Poor business last summer and extraordinary expenses during the winter are given as causes of the road's financial troubles.

NEW BEDFORD, MASS.—An increase in fares amounting to 60 per cent. is in effect on the Middleboro, Wareham & Buzzards Bay Railway Company's line, which has resumed operations after lying idle for several months. Where the former fare from Middleboro to Monument Beach was 25 cents, the present fare is 40 cents, most of the increase being derived in the town of Middleboro. In spite of the increase, those who patronize the line have not complained, as they are pleased that the line is in operation again.

BALTIMORE, MD.—It is expected that within the next thirty days the committee in charge of the affairs of the Washington, Baltimore & Annapolis Railway will have acquired all the claims against the property. The present receivership will then be terminated, and the committee will make efforts to refinance the property so that it may be completed. It is possible, however, that the whole system may be sold to new interests.

NILES, MICH.—The City Council has granted a franchise to the electric railway company promoted by Mr. McMichael, allowing the free right to its streets for his electric road from that city to Eau Claire.

ALMONT, MICH.—There are now prospects for the construction of the electric railway from Romeo to Almont this summer. The survey has been completed and Detroit United Railway officials are securing the right of way.

GREAT FALLS, MONT.—Sam H. Wood is interested in a project to build an electric railway from Great Falls to Choteau, a distance of 60 miles.

MISSOULA, MONT.—The Missoula Light & Water Company is considering the matter of installing an electric street railway in the city and also interurban extensions of the same. Manufacturers should communicate with Mr. S. R. Inch, manager of the light department.

JERSEY CITY, N. J.—A dividend of 1½ per cent. has been declared on Consolidated Traction Company of New Jersey, payable July 15.

SEA ISLE, N. J.—The stockholders of the Sea Isle City Electric Light, Heat & Power Company have disposed of their plant to the New Jersey Rapid Transit Company.

JERSEY CITY, N. J.—The directors of the United Traction & Electric Company of New Jersey have declared the regular quarterly dividend of 1¼ per cent., payable July 1.

MORRISTOWN, N. J.—The Morris County Traction Company, which is to construct an electric railway to connect Springfield, Summit, Chatham, Madison, Morristown, Denville, Rockaway, Dover and Lake Hopatcong, and which is to have branches to Paterson, Boonton, Basking Ridge, Bernardsville and perhaps Somerville, has secured a right of way across Union Township, in Union County, that appears to be satisfactory to every one concerned.

ALBANY, N. Y.—The United Traction Company is installing a storage battery at North Albany, to be used in case of failure of the power from Spier Falls.

NEW YORK, N. Y.—The New York City Railway Company is reported to have closed a contract for 150 new cars, seventy-five of which are for use on the new bridge.

ROCHESTER, N. Y.—It is reported here that J. G. White & Company, of New York, are planning to begin at once the construction of the proposed electric railway between Rochester and Lockport.

BUFFALO, N. Y.—G. Tracy Rogers, president of the Binghamton (N. Y.) Street Railway, who purchased the Buffalo, Hamburg & Aurora Railway at foreclosure here recently says that a contract will be made with the International Traction Company permitting the Buffalo, Hamburg & Aurora cars to run over its tracks into the heart of the city.

BROOKLYN, N. Y.—The Rapid Transit Commission has approved the general layout of the proposed subway under Fourth Avenue, Brooklyn, and instructed its chief engineer, William Barclay Parsons, to prepare detailed plans and drawings of the subway. The route of the Fourth Avenue subway is to be from Fort Hamilton to the Brooklyn approach to the Manhattan Bridge, on Flatbush Avenue, and thence across the bridge to Elm Street, Manhattan.

SYRACUSE, N. Y.—It is reported that a private combination has been formed which will take up the task of building an electric railway from this city to Fulton and Oswego. It is said that the company which it is proposed to incorporate will include stockholders in both the Rapid Transit Company and the Lakeside. It is said the men back of the scheme have come to the conclusion that neither of the corporations at present in existence is likely to build the road, for that reason they have determined to form a company and finance the line themselves.

FARGO, N. D.—A meeting of the stockholders of the Fargo & Moorhead Street Railway Company will be held in Fargo, Aug. 2, to vote upon the question of increasing the capital stock of the company to $300,000, the proceeds of the sale of the stock to be used in the construction of the company's proposed line.

XENIA, OHIO.—The Xenia Council has agreed to grant a city franchise to Colonel J. Richards, of Lebanon, for the new line from Xenia to Lebanon.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Electric Railway Company has changed its name to the Columbus, Mechanicsburg & Western Railway Company and the capital stock has been increased to $2,000,000.

TOLEDO, OHIO.—Officials of the Toledo & Northwestern Railway Company, which proposes to build an electric railway from Toledo to Ann Arbor, Mich., announce that construction work will start at once. Hirsh & Company, of Toledo, have the contract for building the road.

SPRINGFIELD, OHIO.—The Springfield & Xenia Railway Company has been chartered, with $10,000 capital, by H. B. McGraw, A. T. Hillis, G. D. Reed, N. Haas and others. The formation of this company is a step preliminary to the re-organization of the Springfield & Xenia Traction Company, which is now in the hands of a receiver.

TOLEDO, OHIO.—P. S. Willis, C. V. Wagner and George W. Acker are the chief promoters of a company which it is stated will shortly be chartered with $250,000 capital stock for the purpose of building a combined feeder and belt line from the centre of Toledo to Sylvania. The promoters propose to build an independent entrance to Toledo for three interurban roads now building or in operation, to the west and northwest of the city. The company proposes to build a city loop.

PORTLAND, ORE.—The Citizens' Light & Traction Company, capitalized at $200,000, has been incorporated by A. Welch, I. Lowengart, Fred. Langeman, Louis Sommer and M. Hoff.

PORTLAND, ORE.—Plans to convert the West Side line of the Southern Pacific Railroad from Portland to Forest Grove into an electric road are under consideration by the officials in charge of the Harriman lines in Oregon. A. H. Babcock, an electrical engineer connected with the Southern Pacific, is in Portland making the estimates of cost.

PHILADELPHIA, PA.—The stock of the Souderton, Skippack & Fairview Electric Railway has been increased from $100,000 to $300,000.

HARRISBURG. PA.—The Central Pennsylvania Traction Company has prepared plans for an extensive plant, to include larger car houses, repair and paint shops and electrical equipment, at Cameron and Herr Streets.

WEST CHESTER, PA.—The West Chester, Uwchlan & Pottstown Street Railway Company has been organized with a capital of $144,000, to build a 24-mile line between those points. A charter has been granted at Harrisburg.

BRADFORD, PA.—James B. Cahoon and Frank B. Rae, consulting engineers, of New York, have recently made an examination of the street railway systems of Bradford, Pa., and Olean, N. Y., and are planning to consolidate the roads and make extensive improvements.

STROUDSBURG, PA.—The stockholders of the Stroudsburg & Wind Gap Electric Railway Company have appointed a committee to secure estimates on cost of construction of the road from Wind Gap to Saylor's Lake and from the lake to Stroudsburg via two routes. The committee is composed of District Attorney Georhart and Joseph Shiffer, of Stroudsburg; A. C. Young, of Easton, and W. J. Seiple, of Wind Gap.

HARRISBURG, PA.—The United Electric Company, which furnishes the power for 32 miles of electric railway in the Cumberland Valley, is practically rebuilding its power plant at Riverton, opposite this city. A new engine room, 130x60 ft., is being erected, which will give ample room for the four direct-connected units and three more belted engines. An up-to-date equipment of boilers, pumps and condensers has been installed, and the plant complete will have a capacity of 2200-hp. in engines. In addition to this, it is contemplated to put in a large storage battery equipment. A new switchboard is also among the improvements.

FORT WORTH, TEX.—A movement is on foot to build an interurban electric railway between Fort Worth and Cleburne, Tex.

GALVESTON, TEX.—It is reported that the Galveston City Railway Company has been sold to local Galveston interests. Walter G. Oakman, of New York, is vice-president of the company.

DALLAS, TEX.—An application for a charter for the Dallas & Eastern Texas Traction Company is soon to be filed at Austin. Likely the capital stock named will be $250,000. Those who are said to be behind the enterprise are T. L. Marsalis, of Dallas and New York City; W. B. Greenlaw, of Dallas; R. S. Kimbrough, of Mesquite, and Col. Marshall, of Wills Point.

RICHMOND, VA.—It is reported that application has been made for the appointment of a receiver for the Virginia Passenger & Power Company.

NEWPORT NEWS, VA.—The preliminaries are being arranged for the construction of the proposed electric railway to Yorktown. Judge Dudley Smith, of Yorktown, is interested.

RICHMOND, VA.—The Chesapeake Transit Company has applied to the Corporation Commissioner for authority to increase its capital to $1,500,000 from $1,000,000. The company operates an electric road from Norfolk to Virginia Beach.

WINCHESTER, VA.—The Winchester & Washington Electric Railway Company was organized here to build an electric railway from Washington to Winchester. N. H. Hansborough, president of the Shenandoah National Bank, is president, and S. L. Hoover, superintendent of the United Telephone Company, is manager.

LA CROSSE, WIS.—The Council has adopted an ordinance granting the La Crosse & Southeastern Railway Company a franchise to enter the city. This action insures the immediate construction of an electric railway from La Crosse to Viroqua, a distance of 28 miles, and the opening up of fertile sections of Vernon County heretofore without railway connections.

WOODSTOCK, ONT.—The Woodstock Electric Railway, Light & Power Company intends developing a water-power on the Meduxnakik River about 2 miles from this town.

OTTAWA, ONT.—The Ottawa River Railway Company has been organized to build an electric railway from Grenville to Ottawa, with branches. The incorporators include Senator Domville and Senator Owens.

MONTREAL, QUE.—Canadian capitalists, including Sir William Van Horne and William Mackenzie and Hon. George A. Cox, have formed the Rio de Janeiro Tramway, Light & Power Co., Ltd., with a capital of $50,000,000, to operate all tramways and lighting companies at Rio de Janeiro, Brazil.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL INSPECTION & AUDIT COMPANY, of Philadelphia, has been incorporated with a capital stock of $15,000.

THE McDONALD ELECTROLYTIC COMPANY, of New York, has been incorporated with a capital stock of $200,000. The directors are W. S. Woodhull, Francis Dana and J. H. Holmes, of New York.

THE TRAVELING STAIRWAY COMPANY, of New York, has been incorporated with a capital stock of $250,000. The directors are D. M. Quay and T. R. Quay, New York, and Edwin Baltzby, Glen Echo, Md.

THE AMERICAN ELECTRIC & CONTROLLER COMPANY, of Wilmington, Del., with Dover incorporators, has been chartered to acquire patents that cover electric generators and devices. The capital stock is $5,000,000.

THE EVANSVILLE ELECTRIC PLOW AND TRACTION COMPANY has been incorporated at Evansville, Ind., with a capital stock of $50,000. The company's object, as stated in the papers, is to furnish "water, heat, light and power" to corporations, cities, towns and communities. The directors are Frank Elmendorf, M. L. Johnson, C. G. Covert and G. P. Heilman. The company controls the American rights and patents of an electric plow invented by Charles H. Roberts, of Evansville, Ind.

OBITUARY.

MR. CESARE PIO.—We regret to learn from Italy the news of the death of Mr. Cesare Pio, a young electrical engineer who was well known in this city, where he spent some time. He was the son of Mr. Oscar Pio, of Catania, Sicily, where the family is still living. He was a correspondent for the ELECTRICAL WORLD AND ENGINEER, and furnished material for its columns almost up to the time of his death.

PERSONAL.

WALTER H. WHITESIDE.

MR. WALTER H. WHITESIDE.—The latest acquisition to the management of the Allis-Chalmers Company is Mr. Walter H. Whiteside, who has until recently been manager of the Detail and Supply Department of the Westinghouse Electric & Manufacturing Company, of Pittsburg, and, at the same time, general manager of the Sawyer-Man Electric Company, of New York. Mr. Whiteside's experience has been by no means confined to the electrical field. His first business connection dates back to 1881, when he entered the employment of the Hercules Powder Company, the high-explosive or dynamite branch of the DuPont Powder Company, of Wilmington, Del. He introduced their high explosive products into the Lake Superior regions, including the Calumet & Hecla mines, as well as into other mining districts. Four years later he became associated with the Cleveland Electrical Manufacturing Company, of Cleveland, Ohio. He remained with that concern nearly twelve years, serving during the first two years in various capacities, and for the remainder of the time being the manager of its Chicago office. In 1896 Mr. Whiteside was appointed manager of engine sales for the Gates Iron Works of Chicago. In 1898 the Westinghouse Electric & Manufacturing Company made him the manager of its Washington office. In that position he became associated not only with the largest electrical projects undertaken in the district which his office covered, but in other places farther afield. His engineering work in connection with the installation of electrical power in the dry docks of the Navy Department, especially the docks at Kittery, League Island and Charlestown, having been widely recognized. To him was largely due the credit for effecting the change in voltage standardization from 80 to 125 volts in the electric lighting and power installations on board the vessels of the United States Navy. But Mr. Whiteside's best work in the commercial sense was the building up of that immensely successful branch of the Westinghouse Electric organization known as the detail and supply department. Into this department he injected a new life and vigor of administration that brought an admirable reaping of profitable results and won him recognition for marked executive ability. About a year ago Mr. Westinghouse appointed him general manager of the Sawyer-Man Electric Company, of New York, thereby practically doubling his duties. His continued success drew to him the attention of men high-placed in competing lines. Mr. Whiteside is a man of force and also of fine personality. There is no man at the commercial end of the great industrial companies better known throughout the country than he. His new position will be that of general manager of sales for all departments of the Allis-Chalmers Company, including, of course, the Bullock Electric Manufacturing Company, which has become the electrical department of the Allis-Chalmers Company. His experience thoroughly qualifies him for this important duty, which he takes up with the good wishes of his very wide circle of business acquaintance. Mr. Whiteside enters upon his new duties about the middle of July.

MR. A. M. MATTICE, chief engineer of the Allis-Chalmers Co., has returned from his European tour of inspection, and has now settled down to the duties of his position in Milwaukee. While in Europe Mr. Mattice visited the hydraulic machinery works of Escher Wyss & Co., of Zurich, and arranged important details concerning the manufacture in the United States of their lines of product. He also inspected the Nurnberg Gas Engine Works, at Nurnberg, and, at the well-known engineering establishment of Willans & Robinson, at Rugby, England, he paid particular attention to the products and methods of manufacture of the Steam Turbine Advisory Syndicate, of which important organization Allis-Chalmers Co. is the American member. Mr. Mattice had several consultations in London with Mr. Yarrow, the famous torpedo boat builder, on the subject of turbines for marine purposes, and while on the Continent he made, in the Allis-Chalmers interests, a series of exhaustive tests of the Zoelly steam turbine, of which so much has recently been heard.

MR. G. MARCONI has just received the honor of a degree of doctor of science from the University of Oxford, England.

MR. D. MAZENET, managing director of the Mexican General Electric Company, has returned to Mexico City, after a five-weeks' visit to the States.

MR. C. O. MAILLOUX has been retained as electrical engineer regarding the equipment to be installed in the new School of Mines, Columbia University.

MR. S. P. GRACE, chief engineer of the Pittsburg Central District & Printing Telegraph Company, has received from the State University of Wisconsin the degree of master of engineering.

MR. JOHN R. CULLINANE has resigned as secretary of the Denison, Tex., Lighting & Power Company to take up the management of the Texarkana Lighting & Power Company. Mr Cullinane had been connected with the Denison plant since 1886.

MR. HARVEY MOTE, formerly of the construction engineering staff of J. G. White & Company and now with the British Westinghouse Electric & Manufacturing Company, Ltd., was married in London, June 23, to Miss Fenno, a graduate of Cornell University.

MR. E. B. ELLICOTT, chief electrical and mechanical engineer of the Louisiana Purchase Exposition and city electrician of Chicago, gave a lecture on "Some Electrical Features of the Exposition," before the electrical section of the Western Society of Engineers, June 24.

MR. C. H. MACHEN, who has been identified in various capacities with the Cutter Company of Philadelphia for the past three years, and who has been the manager of the New York offices for some time past, has resigned his position with the company, taking effect July 1.

MR. W. S. CONE, formerly foreman of the new steam turbine station of the Edison Electric Company, of Los Angeles, Cal., has accepted a position as chief engineer of the American Falls Power, Light & Water Company, of Pocatello, Ida., and has charge of some extensive steam and hydraulic improvements for that corporation.

MR. EDWARD E. GOUDEY has resigned his position as general manager of the export house of Goudey-McLean Company. Mr. Goudey has associated himself with the firm of B. F. Bell & Company, consulting engineers and contractors, which concern has removed its office to the St. Paul Building. Mr. Goudey retains his interest and remains vice-president of the Goudey-McLean Company.

MR. MARSHALL W. HANKS has resigned from the Nernst Lamp Company and will take up work in Madison, Wis. as a consulting and constructing electrical engineer. In view of the ability displayed by Mr. Hanks in the development of the Nernst lamp, toward which he contributed a long line of inventions, several being fundamental in character, his entry into the general electrical engineering field is a decided acquisition.

MR. RALPH H. BEACH, who for the past seventeen years has been prominently connected with the railway department of the General Electric Company, has resigned his position in order to devote all his attention to the Tula Iron Works Company, of Tula, Mexico, of which concern he has the controlling interest. He will make his permanent home in the southern republic, for which country he and his family left last week. Prior to sailing Mr. Beach was presented with a massive punch bowl as a token of the esteem in which he is held by his old associates in the General Electric Company. Mr. J. J. Malony made the presentation on behalf of the General Electric staff.

NEW INSTITUTE MEMBERS.—The following is the list of 54 new associate members of the American Institute of Electrical Engineers elected June 15: Adams, Charles Francis, electrical engineer, Stanley Electric Co., Pittsfield, Mass.; Baker, I. Fraley, superintendent's office, Sprague Electric Co.; Batson, Walter Vennard, electrical engineer, Boston, Mass.; Bauer, Henry Nicholas, cable electrician, Postal Telegraph Cable Co.; Bennett, Charles Edward, inspector, Allegheny County Light Co., of Pittsburg; Berry, Clyde Albion, telephone engineer, Western Electric Co., New York City; Carman, Charles Whitney, partner, Charles Whitney Carman & Co., Chicago, Ill.; Carroll, Morris B., student, Stevens Institute, Hoboken, N. J.; Coleman, S. Waldo, tester, General Electric Co., Schenectady, N. Y.; Collins, Edgar Francis, foreman, Testing Department, General Electric Co., Schenectady, N. Y.; Dalton, Nelson Wait, electrical engineer, Hartford Carpet Corporation, Thompsonville, Conn.; Dean, Ernest William, resident engineer, Havana Electricity Co., Ltd., Havana, Cuba; Ferrin, Arthur W., chief electrician, American Locomotive Co., Schenectady, N. Y.; Fogarty, John P., Citizens' Telephone Co., Columbus, O.; Foy, John Drewry, assistant electrical and mechanical engineer, Ford, Bacon & Davis, Birmingham, Ala.; Gaillard, Lawrence Lee, electrical engineer, Interborough Rapid Transit Co., New York City; Gardiner, William R., assistant manager, Pittsfield Electric Co., Pittsfield, Mass.; Gibbs, George Slocomb, sales engineer, Westinghouse Electric & Mfg. Co., Boston, Mass.; Gilmore, Jonathan Monroe, foreman, testing room, Stanley Electric Mfg. Co., Pittsfield, Mass.; Glenn, William Harper, superintendent roadways, Georgia Railway & Electric Co., Atlanta, Ga.; Hadfield, Ray Harrison, instructor Iowa State College, Ames, Ia.; Hemphill, William, draftsman, Cataract Power & Conduit Co., Buffalo, N. Y.; Hibbard, Truman, chief engineer, Electric Machinery Co., Minneapolis, Minn.; Horner, Leonard Sherman, representative, Crocker-Wheeler Co., New Haven, Conn.; Jennens, Walter S., as-

sistant engineer, Ontario Power Co., Niagara Falls, N. Y.; Jones, Alfred Howard, salesman, General Electric Co., Empire Building, Atlanta, Ga.; Jones, Budd J., construction engineer, Sargent & Lundy, Chicago, Ill.; Kettering, Charles Franklin, National Cash Register Co., Dayton, Ohio; Latey, Henry Nelms, assistant electrical engineer, Interborough Rapid Transit Co., New York City; Lawton, John Henry, instructor, Iowa State College, Ames, Ia.; Lemmon, George Nelms, engineering apprentice, Westinghouse Electric & Mfg. Co., Pittsburg; Lowenstein, Fritz, consulting engineer, New York City; Mallalieu, Wilbur Emerson, assistant electrical inspector, National Board of Fire Underwriters, New York; McCullough, Richard, St. Louis Transit Co., St. Louis, Mo.; Mercil, Benoni E., engineering department, American Telephone & Telegraph Co., New York City; Morgan, Charles Caldwell, manager, Stanley Electric Mfg. Co., New York City; Morris, Anthony Saunders, engineer and salesman, Westinghouse Electric Mfg. Co., Philadelphia, Pa.; Morton, Alex Amerton, Stanley Electric Mfg. Co., Pittsfield, Mass.; Perry, Alexander, salesman, General Incandescent Arc Light Co., Pittsfield, Mass.; Pielsticker, Fred Alonzo, student, Iowa State College, res. Carroll, Ia.; Playter, Owen Baxter, assistant, Seattle Electric Co., Seattle, Wash.; Rawson, Hobart, electrical engineer, Cincinnati Gas & Electric Co., Cincinnati, Ohio; Scott, Alexander Hugh, student, Iowa State College, Ames, Ia.; Stokes, Hugh Gregorie, engineer aid, U. S. Geographical Survey, Livingston, Ariz.; Stover, Joseph Woodman, president Gamewell Fire Alarm Telegraph Co., New York City; Sullivan, Jeremiah W., chief operator, Postal Telegraph Cable Co., Buffalo, N. Y.; Todd, Robert I., general manager, Rhode Island Co., Providence, R. I.; Treeby, William Vincent, assistant engineer and draughtsman, Macartney, McElroy & Co., Ltd., London S. W., Eng.; Watson, Richard Carr, assistant regulator, New York Edison Co.; Weaver, Amos Sheldon, student, General Electric Co., West Lynn, Mass.; Wehrley, Edward Justus, special agent, American Telephone & Telegraph Co., New York City; Weidman, Victor Nugent, switchboard draughtsman, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; Williamson, Alfred, assistant testing department, General Electric Co., New York City; Wills, Harry LeVague, electrical engineering department, Georgia Railway & Electric Co., Atlanta, Ga.

Trade Notes.

THE CASE MFG. COMPANY, Columbus, Ohio, reports having secured a number of crane orders recently, and an order for 12 "F" type controllers from Jones & Laughlin.

POWER PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has issued a 32 page circular devoted to its line of power pumps, some of which are shown driven by electric motors.

LANE & BODLEY ENGINE.—The Lane & Bodley Company, Cincinnati, Ohio, is sending out a large postal card, showing on its face a "Twentieth Century" heavy duty Corliss engine for all purposes, and on the reverse a large direct-connected unit.

OIL vs. GREASE LUBRICATION is the subject of a very interesting pamphlet issued by the Joseph Dixon Crucible Company of Jersey City, N. J., dealing with the special advantages of Dixon's graphite greases. A remarkable number of good points are made for graphite.

COLUMBIA LAMPS with metal reflectors and Prismo glass shades are the subject of a special catalogue issued by the Columbia Incandescent Lamp Company, of St. Louis. It shows a large variety of such lamps complete and in detail, comprising the ceiling fixtures and other parts. The shades are also well shown.

THE H. T. PAISTE COMPANY, of Philadelphia, Pa., in recent literature, has been directing particular attention to its plain fuseless rosette and back, and standard key and keyless sockets for re-enforced new code cord. The cap of the latter has an opening 7-16 inch inside diameter with the necessary fibre bushing in place instead of the ⅜-inch cap of the regular socket, using in addition a large bushing.

DAY AND NIGHT SIGNS.—The Western Display Company, St. Paul, Minn., has issued a pamphlet showing illustrations of a great variety of designs of its "Reflectric" signs. These signs are equally prominent and conspicuous day or night. For night use the light is reflected upon the sign, the lamps being hidden from view in the framework. This type of sign was described and illustrated in these columns some weeks ago.

C & C "STANDARD" DYNAMOS AND MOTORS.—Bulletin No. 151 of the C & C Electric Company, 143 Liberty Street, New York, is devoted entirely to an illustrated description of the company's type "S" direct current dynamos and motors. Every detail of the machine is carefully explained, many of the parts being illustrated. The usual dimension diagrams are included in the bulletin. Four styles of machines are shown, viz., floor, ceiling, wall and vertical.

FLEXIBLE CONDUIT.—In a folder now being sent out by the Osburn Flexible Conduit Company, 19 Park Row, New York, the requirements of good wiring are enumerated. The company claims that its "Flexduct" solves the question of good interior wiring. This product, we are informed, is approved by all official boards of inspection in the United States. Those who do not know "Flexduct" should get acquainted with it.

TELEPHONE APPARATUS.—The Conn. Tel. & Elec. Company, of Meriden, Conn., reports a big demand for its new and enlarged No. 8 catalogue, which is profusely illustrated with complete telephones and telephone parts. Every exchange man and electrical contractor should have a copy, as the company has placed on the market many new and original telephone designs of high quality. Bulletins and catalogue will be sent on request.

ELECTRIC CRANE CONTROLLERS.—The George H. Smith Steel Casting Company, of Milwaukee, has placed an order with the American Electric Fuse Company, of Chicago, to equip its entire plant with Allen-Bradley electric crane controllers. Thirteen controllers will be installed for use with the four Pawling & Harnischfeger cranes used by the George H. Smith Company. We are informed that this order was placed after Competitive tests of other controllers.

THE AMERICAN CONSTRUCTION COMPANY, of Williamsport, Pa., and Washington, D. C., expects to erect a large plant at Williamsport, Pa., for the manufacture of a special vitrified block to be made from a shale found in this vicinity, and to be used mainly in connection with electric street railway work. The company will require a large machine shop, foundry and other buildings, but its plans have not reached the point where it can give details as to the exact size and equipment required.

THE EMERSON ELECTRIC MFG. COMPANY, of St. Louis and New York, reports a lively demand for the Emerson slow-speed, residential type, alternating current desk fan. This fan is particularly suited for use in sleeping rooms, as it operates with scarcely perceptible noise. The Emerson Company also reports a brisk business in alternating ceiling fans. In addition to the popular four-blade type, this company manufactures a two-blade ceiling fan suitable for soda fountains, candy counters, etc.

THE KEYSTONE ELECTRIC COMPANY, Erie, Pa., is putting on the market a line of multi-voltage dynamos for plating purposes. These machines are so made that any voltage may be obtained, from one to ten volts, and it is asserted than one machine will do for all classes of work. They have been made practical after ten years' careful observation and experience, and it is said they operate without sparking, heating or burning. They are made in sizes from ¾ horse-power up to the largest size required.

THE ENGINEERING COMPANY OF AMERICA, 74 Broadway, New York, which has heretofore been engaged in purely professional work, announces that hereafter it will engage in the general engineering, construction and contracting business, in addition to its strictly professional work. It is now prepared to undertake all kinds of general contracting work, and at the present time has a large amount of work in the office covering electric railway construction, water works, power houses, refrigerating plants, buildings, etc.

STORAGE BATTERIES FOR ALTERNATING STATIONS.—The latest bulletin of the Electric Storage Battery Company is entitled "The Operation of Chloride Accumulators in Connection with the Exciter Circuits of Large Alternating Current Generating Stations." Illustrations are included of the storage battery plant of the Waterside Station of the New York Edison Company and the storage battery auxiliaries of the Brooklyn Edison Company, the Indiana Traction Company and the Memphis Light & Power Company.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., has recently furnished its different types of protective devices to 28 telephone exchanges in the States of Illinois, Missouri, Iowa, Indiana, Ohio, Michigan, Georgia, Nebraska and Indiana. It is also furnishing switchboard equipment of the well-known Sterling single relay, common battery, Bell type for Attica, Ind.; Deposit, N. Y.;; Elkhart, Ind.; Tiffin, Ohio; Charleston, Ill.; Lyons, Ia.; Ottawa, Kan.; Crosswell, Ohio; Boswell, Ind.; Novinger, Mo.; Buck Creek, Ind.; Burr Oak, Mich.

THE CROCKER-WHEELER COMPANY, through its Cincinnati office, has closed contracts for one of the most complete electrical equipments yet ordered for any furniture factory in Central Ohio, the furniture plant being that of the Henry Holtzman & Sons Company, of Columbus. The installation will be made by the Browne-Ryan Electric Company, of Columbus. There are to be fifteen motors, all below 10-hp. The prime mover in the power house is a 100-hp, direct-connected Walrath gas engine. When the plant is fully equipped a large portion of the machinery will be driven by individual electric motors.

PERFECTION BATTERY FANS AND MOTORS.—The American Electrical Specialties Company, 62 Vesey Street, New York, has just issued a timely little pamphlet on the subject of its "Perfection" battery fans and motor outfits. The present weather conditions and fan motors are closely related, and one suggests the other. The advantage of this particular outfit is that the current is supplied by a battery of dry cells, and the possessor of one is independent of electric light supply and can keep cool anywhere, in country or city. The company also handles small motors for power purposes, private line telephones, Christmas tree lamp outfits, etc.

AUTOMATIC TELEPHONE EXCHANGES.—The Automatic Electric Company, of Chicago, has just been awarded contracts to install its automatic telephone system in the cities of Battle Creek, Michigan, and Van Wert, Ohio, replacing manual systems. The Citizens' Telephone Company, of Grand Rapids, Mich., which replaced its manual exchange in that city with the Automatic exchange last winter, is the owner of the Battle Creek system, and the Van Wert Telephone Company is the owner of the Van Wert system. The new Automatic exchange at Battle Creek is to have a present installation of 1000 instruments, with an ultimate capacity of 10,000. The Van Wert exchange is to have a present installation of 925 instruments, with an ultimate capacity of 10,000. The Automatic Electric Company furnishes complete central office and subscribers' equipment in each case.

COOLING THEATRES.—The hot weather is not seriously affecting the Proctor theatres in New York City, which have all been designed or reconstructed with a special reference to an all-year-'round season; electric fans of large diameters are continually exhausting the heated and ventilated atmosphere, replacing it with currents of fresh air, drawn from the roof and cooled before being introduced into the auditorium. In addition to this, palm leaf fans are provided at every seat, and all chairs are covered with linen slips in place of the heating plush. The temperature in various parts of the house is recorded upon the dials of automatic thermometers, and the experience of the past seasons shows that in warm weather the interior temperature is at least ten degrees lower than the exterior theometric readings. There is no harm in letting the public know in this way how cool it can be kept with the aid of electricity.

TANGENTIAL WATER WHEEL.—The Abner Doble Company, of San Francisco, has issued a 48-page pamphlet describing in very complete detail the tangential ellipsoidal water wheel of its manufacture. Illustrations are also given of a number of wheels of this type installed, ranging from a 3700-hp machine, working under a head of 1531 feet, to a small motor for laboratory purposes with plate glass housing. It is stated that a 4000-kw machine has been constructed and is now being installed, the machine running at 400 r.p.m., and driven by a six-inch jet of water. A photograph is given of a 1300-hp wheel taken after one year's continuous running under a head of 1960 feet at 430 r.p.m., buckets being shown in perfect condition. A number of illustrations are included, relating to the Doble needle regulating nozzle, for which an efficiency of 99.3 per cent. has been obtained in recent investigations at the Massachusetts Institute of Technology.

CROSS OIL FILTER AT THE ST. LOUIS FAIR.—The authorities in charge of the power plant at the St. Louis Exposition, have installed a large No. 3 Cross oil filter manufactured by the Burt Mfg. Company, of Akron, Ohio. It is entirely fitting that the oil filter that is recognized as standard by the U. S. Government, by the British Government and nearly every other prominent country on the globe, should receive this recognition from the Exposition managers. Besides the filter used by the Exposition authorities, the Cross oil filter has also been installed by the C. J. Bradley Company, of Pittsburg, for use in connection with its exhibit at the Fair. Likewise the Buckeye Engine Company, of Salem, Ohio, and the De Laval Steam Turbine Company, of Trenton, N. J., have ordered No. 3 American filters, made by the Burt Mfg. Company, to be used at the Fair in connection with their exhibits.

CHANDLER & TAYLOR COMPANY, builder of enclosed automatic engines, Indianapolis, Ind., has just issued a handsome catalogue, Series E-1, devoted to its direct connected and belted engines. The company advises us that it illustrates the first line of engines built in this country to conform to the recommendations of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers for direct connected units. In addition to this very important point, it has embodied in the designs some mechanical principles which have had a thorough try for a period of two years. The engines shown provide for large bearing surfaces; are heavier, it is claimed, than any engine of like power power on the market to-day, and are of the enclosed type. There is no engine which can be adjusted more quickly and more accurately. In fact, the main crank bearing (which needs so much care and which so seldom receives it) can be adjusted while the engine is in operation, and is absolutely self-centering and self-oiling. The company believes that the successful engine to-day is the one that provides large bearing surfaces, a copious supply of oil for these surfaces, that takes care of the oil without wasting it, and provides easy and accurate adjustments. All of these points catch the eye of the engineer.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 21, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St, N. Y.]

762,881. X-RAY APPARATUS; William B. Churcher, Cincinnati, Ohio. App. filed April 11, 1904. An electrolytic cell adapted to allow currents of plus polarity only to pass, and having an anode of variable surface is interposed in circuit with primary on an alternating current supply, for the purpose of sending rapidly interrupted positive currents of different volume through the primary coil.

762,882. SECONDARY BATTERY; James P. Clare, Quincy, Mass. App. filed Oct. 31, 1902.

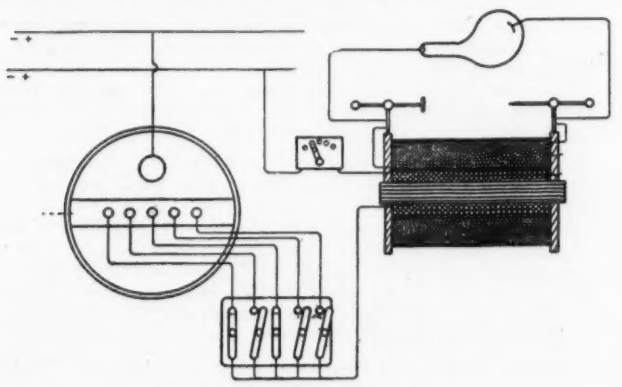
762,957. PARTIAL CIRCUIT FOR ELECTRIC CURRENTS; Guion Thompson, Duluth, Miss. App. filed Aug. 2, 1902. Details of a circuit closer to be used in connection with railway signals.

762,993. CIRCUIT INTERRUPTER FOR JUMP SPARK COILS; Charles H. Fisher, Cincinnati, Ohio. App. filed April 11, 1904. Details.

762,997. RAILWAY SWITCH OPERATING APPARATUS; Marquis D. Hanlon, Wilkinsburg, Pa. App. filed Oct. 8, 1903. An electric clutch is interposed between a motor and a cam cylinder for moving switch rails.

763,002. ELECTRIC LIGHTING APPARATUS; Wm. Knobloch, New York, N. Y. App. filed Oct. 1, 1903. A glow lamp in which the glowers are supported in metal sockets fixed in an insulating base in which is embedded near the surface the heating wires.

763,016. BALL-BEARING TROLLEY WHEEL; James A. Norton, Wilkesbarre, Pa. App. filed Oct. 22, 1903. One arm of the harp swings laterally and carries with it one flange of the wheel, thus making it possible to move the tread of the wheel which is separate from both flanges.



762,881.—X-Ray Apparatus.

763,026. APPARATUS FOR TREATING SEWAGE; William J. Schweitzer, White Plains, N. Y. App. filed July 31, 1903.

763,031. ELECTRIC MOTOR CONTROLLER; Walter N. Vance, Chicago, Ill. App. filed June 29, 1903. Mechanical devices to insure the operation of the controller in proper sequence as to the various positions.

763,042. FIRE ALARM APPARATUS; Loudoun Campbell, Washington, D. C. App. filed Sept. 8, 1903. A lever controlling the openings of the door to the alarm box also controls the sending of the main alarm and the local alarm.

763,046. PNEUMATIC SYSTEM OF MOTOR CONTROL; Fred B. Corey, Schenectady, N. Y. App. filed Dec. 5, 1902. This invention and the next two following relate to a pneumatic system of train control in which a number of train pipes connected with a suitable source of compressed air are used. Admitting air to one pipe operates the reversing switch or switches on the train and while the pressure is maintained in said pipe, air is admitted to a second pipe to start the train; then by properly manipulating the air in the various pipes, the motor connections are changed to increase the speed.

763,047. MOTOR CONTROL SYSTEM; Fred B. Corey, Schenectady, N. Y. App. filed Dec. 5, 1902. See preceding patent.

763,071. MOTOR CONTROL SYSTEM; Charles L. Perry, Schenectady, N. Y. App. filed July 22, 1903. See patent 763,046.

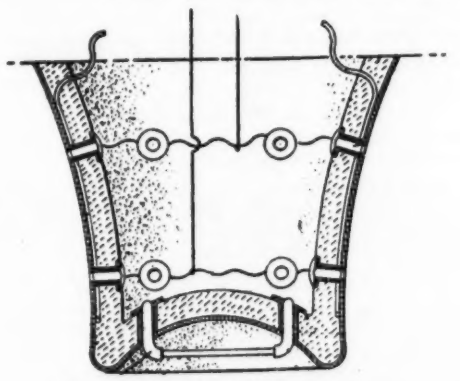
763,082. TELEGRAPH TRANSMITTER; Joseph F. X. Trotier, Montreal, Canada. App. filed July 29, 1903. Details of a hand-key.

763,108. ELECTRIC BRAKE; Frank C. Newell, Wilkinsburg, Pa. App. filed April 1, 1902. Connections between the brake magnet, controller and generator, whereby leakage through the brake magnet is prevented.

763,151. PROCESS OF ELECTRICALLY EXTRACTING ESSENTIAL OIL; George D. Burton, Boston, Mass. App. filed June 27, 1898.

763,152. APPARATUS FOR MAKING EXTRACTS BY ELECTRICITY; George D. Burton, Boston, Mass. App. filed June 27, 1898.

763,168. CURRENT REGULATOR; Justus B. Entz, Philadelphia, Pa. App. filed May 7, 1903. The regulator consists of groups of material whose resistance is varied by pressure, means for changing the pressure upon the



763,002.—Electric Lighting Apparatus.

groups, the material being arranged in relation to a booster-field to cause the booster to regulate the operation of a storage battery.

763,183. ULTRA-VIOLET ELECTRODE; Charles E. W. Horn, New York, N. Y. App. filed April 25, 1904. The electrode comprises a number of insulated discharge terminals grouped in close order and means for compelling an electric discharge to pass through all of said conductors consecutively.

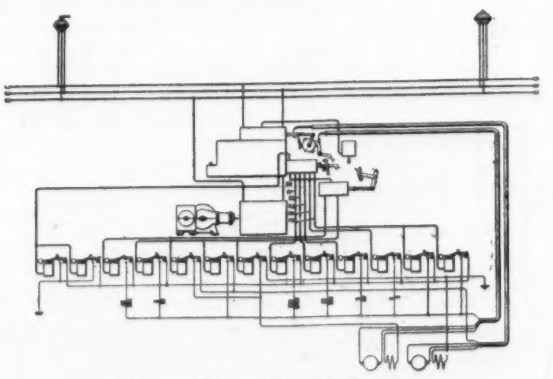
763,223. SAFETY DEVICE FOR STRONG CURRENT OVERHEAD CONDUCTORS; Christian C. Van Der Valk, Voorburg, Netherlands. App. filed Sept. 10, 1903. In case of breakage of a wire carrying a high voltage current, the falling length opens a pair of contacts to entirely separate said length from the circuit.

763,237. ELECTRIC LIGHT FIXTURE; George H. Young, Elmira, N. Y. App. filed April 2, 1904. An insulating lining in the shape of a cone is placed in a canopy to shield the latter from the conductors and joints thereof, covered by it.

763,321. STORAGE BATTERY; Henry C. Porter, Waukegan, Ill. App. filed Nov. 25, 1901.

763,322. BATTERY PLATE; Henry C. Porter, Waukegan, Ill. App. filed July 14, 1902.

763,330. ELECTRIC FURNACE; Charles Prosper Eugène Schneider, Le Creusot, France. App. filed Dec. 22, 1903.



763,071.—Motor Control System.

763,332. RELAY; Burdette S. Smith, Elyria, Ohio. App. filed Feb. 14, 1903. Details.

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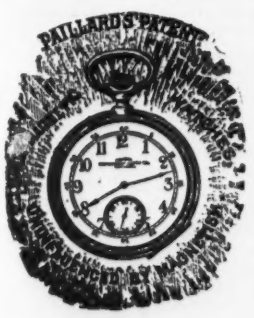

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POSITION WANTED.—By a young man experienced in the manufacture, testing, estimating and installation of wires and cables for all purposes; can furnish best of references; would like to make change by August 1. Address No. 1534, care Electrical World and Engineer, New York.

POSITION WANTED.—As manager or superintendent of lighting or railroad company, or would take charge of testing department of large concern; have had eight years' experience in the lighting and power field and am at present in charge of a department of one of the largest manufacturing concerns; good executive ability. Address No. 1525, care Electrical World and Engineer, New York.

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1	500	Wood, 25-K.W.
1	900	West., 45-K.W., 2 phase.
2	1200	West., 60-K.W.
1	1500	Warren-Medberry, 75-K.W.
1	1500	West., 75-K.W.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine.
1	1500	Wood, 75-K.W.
1	2400	Gen. Elec., 120-K.W., 3 ph.
2	3000	Warren, 150-K.W.
1	7200	Gen. Elec., 360-K.W., 3 ph.

ALTERNATORS—125-133 CYCLES

Lt.		
1	650	Wood, 33-K.W.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W.
1	900	Warren-Medberry, 45-K.W.
1	1000	Wood, 50-K.W.
2	1200	Gen. Elec., 60-K.W.
1	1500	Stanley, inductor, 75-K.W.
1	2400	Gen. Elec., 120-K.W., A 120.
2	2400	Gen. Elec., 120-K.W., A.S.120.
2	3000	Stanley inductor, 150-K.W.
1	4000	Westinghouse, 240-K.W.

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Lt.		
2	35	Hobart, Multipolar.
1	45	Lundell.
3	45	Westinghouse, Multipolar.
1	50	Crocker-Wheeler.
2	50	Northern, Multipolar.
1	50	Westinghouse, Multipolar.
2	60	Hobart, Multipolar.
1	80	Fort Wayne, Multipolar.
1	80	Crocker-Wheeler.
3	80	Riker, Multipolar.
1	80	Perrett, Multipolar.
1	100	Card, Multipolar.
2	110	Commercial, Multipolar.
1	150	Edison.
1	150	Eddy, Multipolar.
1	150	Western Elec., Multipolar.
1	150	General Electric, Multipolar.
1	160	Triumph, Multipolar.
1	165	Am. Engine Co., Multipolar.
1	210	Edison.
1	210	Phoenix, Multipolar.
1	210	Eddy, Multipolar.
1	225	Card, Multipolar.
1	260	Commercial, Multipolar.
1	300	Phoenix, Multipolar.
1	300	Perritt, Multipolar.
1	300	Ahlms-Edwards, Multipolar.
2	300	Gen. Electric, Multipolar.
1	300	Western Elec., Multipolar.
2	350	Edison, 20-K.W.
2	350	C. & C., Multipolar.
1	400	Northern, Multipolar.
1	400	Crocker-Wheeler, Multipolar.
2	400	Westinghouse, Multipolar.
2	450	Edison, 25-K.W.
2	450	Commercial, Multipolar.
1	450	Quaker City, Multipolar.
1	450	Triumph, Multipolar.
2	450	Sprague-Lundell, Multipolar.
1	450	Eddy, Multipolar.
1	450	Gen. Electric, Multipolar.
1	450	Western Elec., Multipolar.
1	540	Edison, 30-K.W.
1	540	C. & C., 30-K.W.
1	540	Elwell-Parker, Multipolar.
2	540	Gen. Elec., Multipolar.
3	600	Card, Multipolar.
1	650	Milwaukee, Multipolar.
1	650	Westinghouse, Multipolar.
1	650	Westinghouse, Multipolar, 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine.
2	700	Commercial, Multipolar.
1	700	Card, Multipolar.
1	700	Crocker-Wheeler, Multipolar.
1	900	Wagner, Multipolar, comp.
1	1000	Edison, 60-K.W.
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.
1	1100	Triumph, Multipolar.
1	1300	Card, Multipolar.
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine.
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.
2	1350	Gen. Elec., Multipolar, 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine.
2	1800	Edison, 100-K.W.
1	1800	Western Electric, Multipolar, comp., 6 pole, 100-K.W.
1	2200	Western Electric, Multipolar, 125-K.W., 6 pole.
2	2500	Western Electric, Multipolar, comp., 150-K.W., direct connected to 16x18 McEwen engine.

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1	9	New England, Multipolar.
2	10	T.-H.
1	12	Western Elec., Multipolar.
1	17½	Kester.
1	17½	Eddy.
1	20	Western Electric.
1	20	Keystone, Multipolar.
1	20	Eddy, Multipolar.
2	20	Western Elec., Multipolar.
2	30	C. & C.
1	40	C. & C., Multipolar.
1	40	Eddy, Multipolar.
1	45	Edison.
1	45	Am. Engine Co., Multipolar.
1	45	Western Elec., Multipolar.
1	45	C. & C., Multipolar.
1	45	Gen. Elec., Multipolar.
1	50	C. & C.
1	50	Commercial, Multipolar.
1	50	Maine, Multipolar.
1	55	Fuller, Multipolar.
1	55	Eddy, Multipolar.
1	60	Northern, Multipolar.
1	75	Siemens & Halske, Churchward type, Multipolar, direct connected to 14x14 Ideal engine.
1	80	C. & C.
1	100	Commercial, Multipolar.
1	125	Eddy, Multipolar.
1	150	National, Multipolar.
1	200	Eddy, Multipolar.
1	200	Westinghouse, Multipolar.
1	250	Western Elec., 6 pole.
1	300	Western Elec., Multipolar.

500 TO 550 VOLT COMPOUND GENERATORS.

K.W.		
1	60	Edison.
1	62	T-H.
1	75	Akron, 6 pole.
2	75	General Electric.
1	100	Siemens & Halske, 4 pole.
2	100	Edison.
1	100	Gen. Elec.
2	120	Westinghouse.
1	200	Thompson-Ryan.
1	200	General Electric.

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42-K.W. 220 V. Westinghouse, Alfrey.
30-K.W. 500 V. Gen. Elec. Arm. Sims.
50 K.W. 110 V. Eddy, Ames.
37-K.W. 110 V. West., Erie Ball.
30-K.W. 110 V. Westinghouse, Ames.
8-K.W. 110 V. Crocker-Wheeler, Case.

110 VOLTS DIRECT CURRENT
Dynamos or Motors

85-K.W. Gen. Electric, M. P.
75-K.W. Gen. Electric, M. P.
45-K.W. General Electric.
15-K.W. Eddy, M. P.
7½-H.P. Gen. Elec., Type C E.
5-H.P. Gen. Elec., Type C E.
3-H.P. Gen. Elec., Type C E.
1-H.P. C. & C.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

150-K.W. Westinghouse.
75-K.W. Westinghouse.
55-K.W. Gen. Elec., M. P.
45-K.W. Edison.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. Sprague.
7½-H.P. Edison.
5-H.P. Diehl.
2-H.P. Diehl.

500 VOLTS DIRECT CURRENT

75-K.W. Westinghouse, M. P.
15-H.P. Westinghouse, M. P.
1-H.P. Westinghouse, M. P.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

40-H.P. Type C Westinghouse.
30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
5-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.

2 Phase, 440 Volts, 60 Cycles

100-H.P. Westinghouse.
40-H.P. Westinghouse.
30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
5-H.P. Gen. Elec., 110 V.
3-H.P. Westinghouse, 110 or 220 V.
2-H.P. Westinghouse, 220 V. or 110V.

1 Phase, 60 Cycles

5-H.P. Wagner.
2-H.P. Wagner.
1-H.P. Wagner.
½-H.P. Wagner.
½-H.P. General Elec.

1 Phase, 125 Cycles

20-H.P. Wagner.
10-H.P. Wagner.
5-H.P. Wagner, 110 volts.
¼-H.P. Emerson.

Large stock of small motors, auto-starters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

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MR. N. D. BALLANTINE, Supt. Telegraph, Kansas City, Mo., says:—"I find it an exceptionally good flux and will specify 'Crescent' when ordering."

CRESCENT Soldering Sticks and CRESCENT SOLDERING PASTE

are made a little better than any other man can make, because we "want to," and know how, and have the facilities and experience.

ASK YOUR DEALER FOR THEM, or send us 75c. and we will mail you a sample half dozen.

BARGAINS

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed and actually in stock.

ARC DYNANOS.

	Lt.	C.P.	
1	35	2000	T.-H., L D 2 ball.
1	50	1200	T.-H., L D 12, new ball.
2	50	2000	T.-H., M. D 2, s-o., ring.
1	75	1200	T.-H., M D 12 s-o.
1	75	1200	Wood.
1	125	1200	Excelsior.

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.
1	1	General Electric, type I B.
1	2	Lundell.
1	2½	Riker.
1	3	C. & C.
1	3	Bernard, Multipolar.
1	3	Gibbs, Multipolar.
1	3	Lundell.
3	3	Western Electric, Multipolar.
3	3	Westinghouse, Multipolar.
1	3½	Eddy, Multipolar.
1	4	Commercial, Multipolar.
2	5	Gibbs, Multipolar.
3	5	Hobart, Multipolar.
5	5	Western Electric, Multipolar.
1	5	Eddy, Multipolar.
3	5	Belknap, Multipolar.
2	5	Crocker-Wheeler special printing press motors, direct con.
1	6½	Jenney, Multipolar, back geared.
1	7½	Edison.
2	7½	Western Electric, Multipolar.
1	7½	Milwaukee, Multipolar, series.
1	8	Holtzer-Cabot.
1	8	Crocker-Wheeler, series.
1	8	Maine, Multipolar.
1	10	Standard, Multipolar.
1	10	C. & C., Multipolar.
1	10	Keystone, Multipolar.
1	10	Western Electric, Multipolar.
2	10	Westinghouse, Multipolar.
3	10	Bernard, Multipolar.
1	15	Keystone, Multipolar.
1	15	New England, Multipolar.
1	15	Western Electric, Multipolar.
1	18	Edison, 15-K.W.
1	20	Eddy.
1	20	Kester.
2	25	Edison.
1	25	Western Electric.
1	25	Keystone, Multipolar.
1	25	Eddy, Multipolar.
1	25	Western Electric, Multipolar.
2	40	C. & C.
1	40	Sprague-Lundell, Multipolar.
1	50	C. & C., Multipolar.

	H.P.	
1	50	Eddy, Multipolar.
1	50	Am. Engine Co., Multipolar.
1	60	C. & C.
1	60	Edison.
1	60	Commercial, Multipolar.
1	60	C. & C., Multipolar.
1	60	Maine, Multipolar.
1	60	Western Electric, Multipolar.
1	60	General Electric, Multipolar.
1	65	Eddy, Multipolar.
1	70	Fuller, Multipolar.
1	75	Northern, Multipolar.
1	85	Western Electric.
1	100	C. & C.
1	125	Edison.
1	135	Commercial, Multipolar.
1	150	Eddy, Multipolar.
2	200	National, Multipolar.

500 TO 550 VOLT MOTORS.

	H.P.	
1	1	General Electric.
2	1½	Northern, series.
2	1½	Crocker-Wheeler.
1	2½	New England.
1	3	C. & C.
1	3	General Electric.
1	3	Jenney, Multipolar.
1	3½	Westinghouse, Multipolar.
1	4	Edison.
1	4	Bernard, Multipolar.
1	5	Fort Wayne.
2	5	Triumph, Multipolar.
3	5	Crocker-Wheeler.
1	6	C. & C., enclosed.
1	7½	Card, Multipolar.
1	7½	Jenney, Multipolar.

	H.P.	
1	7½	C. & C., Multipolar.
3	7½	Crocker-Wheeler.
1	7½	Eddy, Multipolar.
1	10	Phoenix, Multipolar.
1	10	Crocker-Wheeler.
1	10	Northern, Multipolar.
1	10	Triumph, Multipolar.
2	10	General Elec., Multipolar.
1	10	Perrett, Multipolar.
1	10	Eddy, Multipolar.
3	10	Belknap, Multipolar.
1	12	Am. Engine Co., Multipolar.
1	15	Eddy.
1	15	C. & C.
1	15	Edison.
1	15	Perrett, Multipolar.
1	15	Maine, Multipolar.
1	20	Eddy.
1	20	Perrett, Multipolar.
1	20	Holtzer-Cabot, Multipolar, enclosed.

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.	
2	½	Stanley, 110 volts.
1	½	Holtzer-Cabot, 104 volts.
1	½	Emerson, 104 volts.
1	½	Wagner, 104 volts, automatic.
1	1	Fort Wayne, 104 volts.
1	1	Wagner, 208 volts, automatic.
1	1½	Wagner, 208 volts, automatic.
1	3½	Wagner, 110 volts, automatic.

THREE PHASE. 125-133 CYCLES.
For Monocyclic System.

	H.P.	
1	3	General Electric, 110 volts.

SINGLE PHASE. 60 CYCLES.

	H.P.	
1	¼	General Electric, 110 v.
1	1	Phillips, 208 volts.
1	1	Phillips, 104 volts.
1	2	Wagner, 208 volts, automatic.
1	2	Wagner, 104 volts.
1	3	Wagner, 208 volts, automatic.
1	30	Wagner, 104 volts, automatic.

TWO PHASE. 60 CYCLE.

	H.P.	
1	2	General Electric, 220 volts.
1	5	Westinghouse, 220 volts.
1	50	Westinghouse, 400 v.
2	100	Westinghouse, 400 v.

THREE PHASE. 60 CYCLE.

	H.P.	
2	1	General Electric, 110 volts.
1	2	General Electric, 110 volts.
2	2	General Electric, 220 volts.
1	5	Gen. Elec., 110 volts.
1	10	Gen. Elec., 110 volts.
1	15	Gen. Elec., 110 v.
1	30	Gen. Elec., 110 v.

ELECTRIC LOCOMOTIVES.

	Ton.	
1	10	Morgan-Gardner, type M, 250 v. direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour.
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour.

For Sale:—Four 22' and 42' x 48'

Hamilton Tandem Compound Condensing Corliss Engines

With Independent Condenser for Each. Wheels: 24 ft. x 50 ins. 60,000 lbs. Capacity: 750 to 1,000 H. P. Each. Located in New York City.

900-H.P. 34x60 International Power Corliss.
450-H.P. 16 and 30x42 Allis Compound Corliss.
450-H.P. 24x48 Brown Corliss.
400-H.P. 23x60 Geo. H. Corliss.
300-H.P. 20x48 Harris Corliss.
275-H.P. 20x42 Hamilton Corliss Engine.
225-H.P. 18x42 Hamilton Corliss.
200-H.P. 18x36 Bates Corliss.
200-H.P. 12 and 22x42 Atlas Compound Corliss.
175-H.P. 16x42 Allis Corliss.
150-H.P. 15x38 Brown Corliss.
125-H.P. 14x36 Putnam Corliss.
100-H.P. 12x36 Harris Corliss.
85-H.P. 12x30 Lane and Bodley Corliss.
650-H.P. 28½x52 Buckeye Automatic.
450-H.P. 24x48 Buckeye Automatic.
400-H.P. 16½ and 28½x27 Buckeye Compound Automatic.
250-H.P. 16 and 27x16 Westinghouse Compound.
100-H.P. 13x12 Ideal S. O. Automatic.
90-H.P. 12x20 Atlas Side Crank Automatic.
90-H.P. 12x16 Erie Center Crank Aut.
40-H.P. 9x13 Frost Side Crank Automatic.

BOILERS

1—350-H.P. Babcock and Wilcox Boiler, 150 lbs.
1—280-H.P. Babcock and Wilcox Boiler, 150 lbs.
2—265-H.P. Babcock and Wilcox Boilers, 150 lbs.
3—265-H.P. Babcock and Wilcox Boilers, 135 lbs.
1—175-H.P. Babcock and Wilcox Boiler, 125 lbs.
1—172-H.P. Babcock and Wilcox Boiler, 130 lbs.
1—250-H.P. Cahall Vertical Boiler, 160 lbs.
14—72x22 Tubular Boilers, 115 lbs.
7—72x18 Tubular Boilers, 120 lbs.
7—72x18 Tubular Boilers, 100 lbs.
3—72x16 Tubular Boilers, 100 lbs.
8—66x18 Tubular Boilers, 100 lbs.
3—66x16 Tubular Boilers, 100 lbs.
1—60x18 Tubular Boiler, 100 lbs.
4—60x16 Tubular Boilers, 100 lbs.
2—60x14 Tubular Boilers, 120 lbs.
Cookson Heaters, 50, 75, 100, 150 and 200 H.P.

WHITEHEAD MACHINERY CO., Davenport, Iowa.
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Electric Light Plant in town of over 15,000 inhabitants. We also have a purchaser for a combination gas and electric plant in town of over 10,000 inhabitants. Describe fully, stating equipment and prices.

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RAILWAY GENERATORS

2—500-K.W. General Electric Railway Generator.
1—400-K.W. General Electric Railway Generator, direct connected.
3—200-K.W. Edison Bi-polar Railway Generator, prime condition.
2—200-K.W. Westinghouse 6 pole Railway Generator.
1—150-K.W. General Electric 6 pole Railway Generator.

60-CYCLE ALTERNATORS

1—700-K.W. 60 cycle, three phase Westinghouse, three bearing.
1—300-K.W. 60 cycle, General Electric, direct connected.
2—250-K.W. 60 cycle, General Electric, 3 phase, type A. T. B.
1—150-K.W. 60 cycle, General Electric, monocyclic.
1—120-K.W. 60 cycle, Westinghouse, 2 phase.
3—120-K.W. 60 cycle, General Electric, single phase.
1—100-K.W. 60 cycle, General Electric, three phase.
1—75-K.W. 60 cycle, Ft. Wayne Wood, single phase.

133 Cycle

1—300-K.W. Stanley, 2 phase.
3—150-K.W. Ft. Wayne Wood, single phase.
2—120-K.W. General Electric, single phase.

DIRECT CURRENT.

2—200-K.W. Edison Bi-polars, 250 volts, compound-wound.
1—100-K.W. 8 pole General Electric, 125 volts, direct connected to 15½ x16 New York Safety Engine.
1—100-K.W. 6 pole Western Electric, 125 volts, direct connected to 16x16 Ideal, latest type.
175-K.W. and 100-K.W. Edison Bipolars.
1—160-Light Ft. Wayne Wood Arc Machine.

We list no Engines here, but will send list of Engines, Corliss and Automatic, simple or compound, of all types, upon request. Write what you want.

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DIRECT CONNECTED.

30-K.W. Eddy dynamo to Watertown engine, 110 volts.
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10-K.W. Westinghouse dynamo to Westinghouse engine, 110 volts.
80-Amp. Edison dynamo to Brotherhood engine, 80 volts.
20-H.P. Elektron 220 volt motor to Morse Williams freight elevator.

BELTED.

60-amp. Crocker-Wheeler to Herresoff engine, 110 volts.
2000 volt Electro Dynamic arc dynamo, 10 amperes.
500-Lt. Edison dynamo, 110 volts.
60-amp. Westinghouse dynamo to Westinghouse engine, 110 volts.
35-amp. Sprague dynamo to Hornby Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
500-Lt. Edison Dynamo, 110 volts, D.C. to Brotherhood engine.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
30-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts, with spare armature.
15 General Electric, 2-H.P., 220 volt motors.
12 Siemens & Halske 5-H.P., 220 volt motors, 220 volts, 1550 R.P.M.
2 search lights.

These motors are dust proof and series wound.

Large stock of smaller dynamos and motors.

Repairing of electrical machinery in all its branches.

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FOR BARGAINS OF DISTINCTLY BETTER QUALITY

4—75 K.W. G. E. 125 Volt M. P. Generators.
2—120 K.W. 2240 Volt A. C. General Electric.
2—120 K.W. 2240 Volt A 60 General Electric.
2—120 K.W. 2240 Volt A 70 General Electric.
3—8 circuit, 125 Light, 9.6 ampere brush arc dynamos.
800 M 2 double T. H. open arc dynamos.
200 M 2 single T. H. open arc dynamos.

500 VOLT.

1—600 K.W. G. E. M. P. type.
1—225 K.W. G. E. M. P. type.
2—275 K.W. Westinghouse direct connected.
1—225 K.W. Westinghouse direct connected.

ENGINES.

2—750 H.P. Allies to Cross Compound.
2—500 H.P. Ball Cross Compound.
1—1500 H.P. Pa. Iron Works.

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350 Ceiling Fans, 110 Volt, various makes and finish, all in good order.

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Machinery of all kinds bought, sold and exchanged.

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FOR SALE: In Alabama.

2—A-6 Thomson-Houston Alternators, single phase, 1100 volt, 125 cycle, slotted type armature.
1—Extra armature for above.
1—Thomson-Houston M-12 arc dynamo.
1—Thomson-Houston L. D.-12 arc dynamo.
1—L. D.-12 armature.
1—14"x16" McEwen High Speed Automatic Engine.
1—Westinghouse alternator, 75-K.W., 60 cycle, 2200 volt, single phase.

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FIRST-CLASS EQUIPMENT THROUGHOUT.

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CORRESPONDENCE SOLICITED.

PROPOSALS FOR LIGHTING

Notice is hereby given that sealed proposals will be received by the Light and Water Committee of Councils of the City of Williamsport, Pennsylvania, till 12 o'clock noon of Friday, July 29, A. D. 1904, for the lighting of the streets of Williamsport with the most modern system of electric lighting, every night and all night for a period of five years, also for a period of ten years, from December 1, 1904; ALSO bids for lighting the City Hall and the several Fire Engine Houses of the City for similar periods. Bids for Street Lighting to state the kind and number of lights to be furnished, the system of lighting, the candle power and distribution of lights. Bids to be accompanied by a certified check in the sum of Five Thousand Dollars ($5,000.00), upon one of the banks of Williamsport, said amount to be forfeited as liquidated damages in case the successful bidder fails to execute contract and furnish the required bond. The City reserves the right to reject any or all bids. Bids are to be sent to the City Clerk, endorsed "PROPOSALS FOR ELECTRIC LIGHTING." The successful bidder shall have the privilege of erecting poles, wires, etc., for the purpose of furnishing lights for the streets of the City, the Fire Engine Houses and City Hall, as well as for commercial purposes, under such regulations as Councils may by ordinance provide. All information in regard to number of lights, location of same, etc., can be obtained of the City Clerk, Williamsport, Pa.

J. J. GALBRAITH, City Clerk
A. F. YOUNG, Chairman of Light and Water Committee

FOR SALE

Two 250 K.W., 10,000 volt generators.

General Electric, three-phase, 60 cycle, revolving field type, belted machines with exciters and marble switchboard.

Portland Lighting & Power Co.
Portland, Maine

FOR SALE

One Waverly Electric Runabout and several small Gas and Gasoline Engines :: :: :: ::

W. F. WARNER
MUNCIE, IND.

SWITCH BOARD CHEAP

9 panels of blue Vermont marble, 90" high by 28" wide and 2" thick in two parts. Top panel 65" high, sub-base 25" high. Six of these panels are designed for 4 wire 3 phase Feeder panels, each one mounting 1 Elden Automatic Oil Circuit Breaker, 4 pole, 100 ampere, 4500 volt 4 single pole S. T. knife switches with marble barriers, 100 amperes, 4500 volts.

3 Wagner Ammeters; 80 ampere with current transformers.

1 Mershon Volt meter Compensator arranged to plug on either phase.

3 Goose Neck Ills lamp brackets.

1 panel containing 1-10 ampere Ammeter with current transformer.

2 primary plug switches for arc circuit 10 ampere 5000 volts.

1 panel containing 2 Elden Auto oil circuit breakers, 200 ampere 4500 volts, 3 pole.

2 hand operated 3 pole S. T. oil switches, 100 ampere 4500 volts Elden make.

1 total load panel mounting. 1 Elden Auto oil circuit breaker 100 ampere, 4 pole, 4500 volt. 1 4 pole knife switch, 150 ampere, 4500 volts with marble barriers. 3 Wagner Ammeters 150 ampere with current transformers. 3 Stanley Recording Primary Wattmeters, 200 ampere.

Also one Swing bracket mounting 2 Wagner Volt meters, 150 volt with potential transformer. One arranged to be used with compensators and one to read Buss bar voltage.

2 Station Ground Detectors.

The Board has mounted on back 1 set (4 wire) Buss Bars, and all interconnections to switches, instruments, etc.

All the instruments and switches are in perfect condition, good as new, same being in use only two and one-half years, and can be seen in daily operation at our Power House.

Reasons for selling on account of being too small, and our intention to put in new board of larger capacity. Address.

UNION LIGHT, HEAT & POWER COMPANY
COVINGTON, KENTUCKY.

FOR SALE

1—150-K.W. 60 cycle 1040 volt G. E. monocyclic alternator, A-1 condition, $1000, f.o.b.
1—12x12 Erie Ball Engine, fine condition, $300, f.o.b. Address

No. 1521,
care Electrical World and Engineer New York

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STEAM PUMPS

2—14x20x17x18 Knowles Compound Duplex.
1—12x24x18x10 Deane Compound Duplex.
2—14x20x10x15 Worthington Compound Duplex.
3—9x17x15x15 Worthington Compound Duplex.
1—10x16x8½x10 Worthington Compound Duplex.
1—18x18x10 Deane Duplex.
1—14x9x12 Snider-Hughes Duplex.
1—12x5x12 Hall Duplex.
1—20x5¾x18 Knowles Duplex Mining.
1—20x5x16 Knowles Duplex Mining.
1—7½x10¼x10 Worthington Duplex.
3—10x6x10 Worthington Duplex.
1—10x6x10 Blake Duplex.
2—9x5¼x10 Worthington Duplex.
3—7½x4½x10 Worthington Duplex.
1—7½x4½x6 Worthington Duplex.
1—9x3x10 Worthington Duplex.
2—6x5¾x6 Deane-Holyoke Duplex.
3—6x4x6 Smith-Vaile Duplex.
7—6x4x6 Worthington Duplex.
2—6x4x6Deane-Holyoke Duplex.
2—5¼x3½x5 Worthington Duplex.
1—5¼x3½x5 Deane-Holyoke Duplex.
3—4½x2¾x4 Worthington Duplex.
1—4½x2¾x4 Barr Duplex.
5—3x2x3 Worthington Duplex.
1—10x12x12 Delamater single.
1—8x10¼x12 Laidlaw - Dunn - Gordon single.
2—10x6x13 Cameron single.
1—10x6x12 Knowles single.
1—10x6x12 Blake single.
1—8x5x12 Knowles single.
1—5x3¼x7 Knowles single.
1—3½x2x4 Foster single.
1—3¼x2x4 Knowles single.
1—3x1¾x3 Knowles single.
1—4x6 Knowles Triplex.
1—1¾x2½ Goulds Triplex.

AIR COMPRESSORS

1—24x24x30 Rand single.
1—24x24x30 Ingersoll-Sergeant single.
1—18x30x36 Blake Duplex.
1—16x18x36 Newburgh Duplex.
1—10x10x10 Ingersoll-Sergeant Duplex.
1—14x15 Clayton belted.

We are dealers in new and second-hand machinery for Contractors, Railroads, Mines, Quarries, and Manufacturing Plants.

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1 or 2 125 or 150 k.w. 110 or 220 volt generators, either direct connected or belted.

WYKES BROS.
SAGINAW, MICH.

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Alternating and direct-current Motors, Dynamos, at bargain prices. Send in your requirements and we will be pleased to quote you. Lot of A. C. and D. C. Desk and Ceiling Fans cheap.

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FOR SALE

Owing to change to 60 cycles, we have about 40 125 cycle, 1000 volt to 100 volt transformers, varying in size from 10 to 375 lights. Also 25 Guttman & Westinghouse wattmeters and one 50-light T.H. series arc dynamo; also two 50-K.W. 1000 to 2000 volt alternators, Stanley and T.H. Above for sale at a bargain. Moscow Electric Light & Power Co., Moscow, Idaho.

FOR SALE

A good paying small electric light plant in growing town of 1200 in Indiana. Plant all in first-class condition with cheap fuel and good city contract. Runs until 11 P. M. and one man can handle same. If plant is sold at once it can be bought for $4200, part down, balance long time. Address quick. E. S. Aldrich, Moscow, Idaho.

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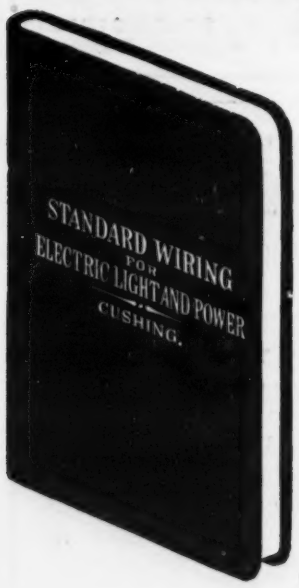

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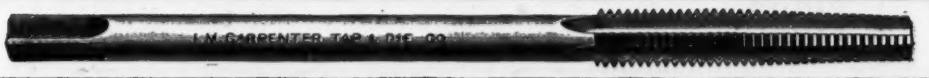

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The National Electrical Code (Supplement April, 1904)

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"FLEXDUCT"

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Its peculiarly woven construction makes it impossible to rip out the inside. Try it and see.

The safest insulator because of its non-detachable interior.

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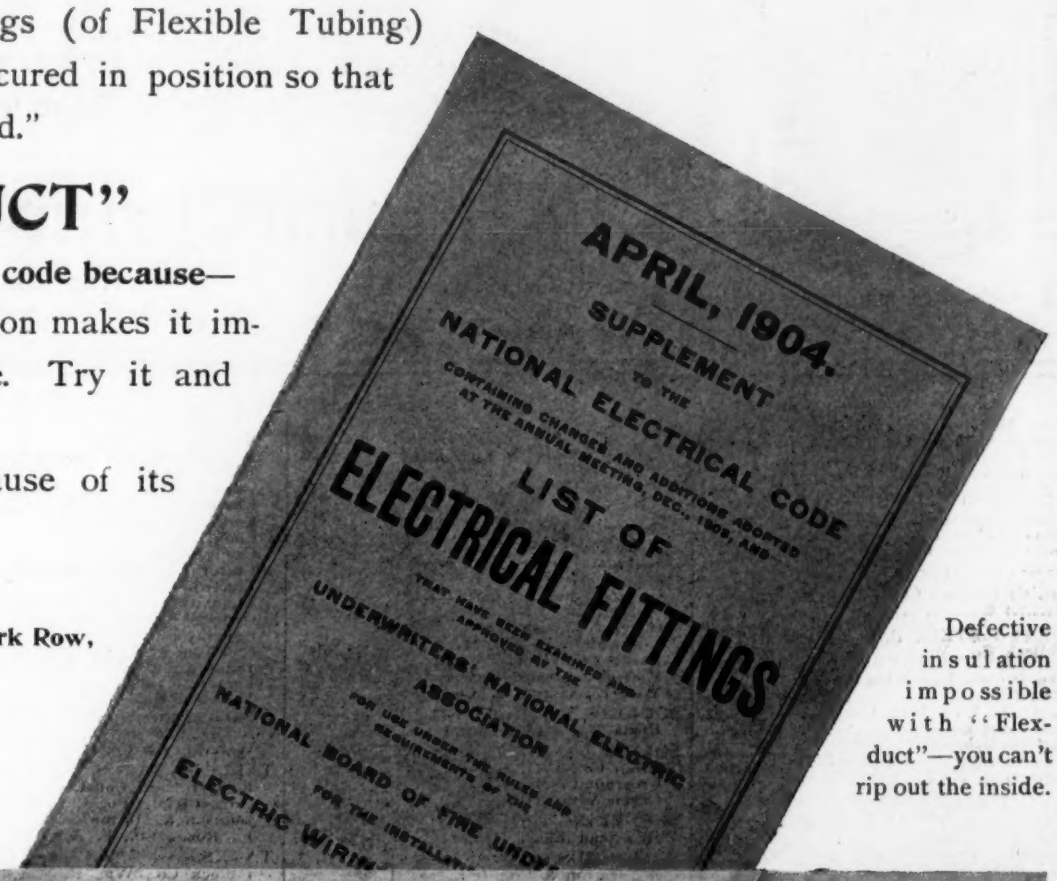
APRIL, 1904.
SUPPLEMENT
TO THE
NATIONAL ELECTRICAL CODE
CONTAINING CHANGES AND ADDITIONS ADOPTED AT THE ANNUAL MEETING, DEC., 1903, AND
LIST OF
ELECTRICAL FITTINGS
THAT HAVE BEEN EXAMINED AND APPROVED BY THE
UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION
FOR USE UNDER THE RULES AND REQUIREMENTS OF THE
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FOR THE INSTALLATION OF
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Defective insulation impossible with "Flexduct"—you can't rip out the inside.

Flexduct is moisture proof, is the best mechanical protector.

Has the smoothest interior.

Is the most flexible.

This is what the Code says. Have you read it?

Write for our interesting booklet giving full particulars about "Flexduct."

6 LIST OF ELECTRICAL FITTINGS.

Also amend by striking out the second paragraph of the fine print note.

Rule 43*x*. Amend to read as follows:

"The insulation must consist of layers of cotton or other thread, all the interstices of which must be filled with the fireproofing compound, or of material having equivalent fire resisting and insulating properties. The outer layer must be braided and specially designed to withstand abrasion. The thickness of insulation must not be less than that required for slow-burning weatherproof wire and the outer surface must be finished smooth and hard."

"The solid constituent of the fireproofing compound must not be susceptible to moisture, and must not burn even when ground in an oxidizable oil, making a compound which, while proof against fire and moisture, at the same time has considerable elasticity, and which when dry will suffer no change at a temperature of 250° F., and which will not burn at even a higher temperature.

Rule 50 C. Flexible Tubing.

The following specifications are designed to cover the construction of flexible tubes for fished work, loop system and for mechanical protection to wires where not exposed to moisture.

Tubes complying with these requirements must not be used for a conduit system of wiring.

a. Must be constructed to meet the following requirements:

Must have a sufficiently smooth interior surface to allow the ready introduction of the wire.

Must be constructed of or treated with materials which will serve as moisture repellants.

Must have a substantial outer covering especially designed to withstand abrasion.

b. The linings must be secured in position so that they cannot be readily removed.

c. The tube must be thoroughly flexible at all temperatures at which it is to be used.

LIST OF ELECTRICAL FITTINGS. 7

d. Must not crack or break when kinked or flattened out.

e. Must be sufficiently tough and tenacious to withstand severe tension without injury; the interior diameter must not be diminished or the tube opened up at any point by the application of a reasonable stretching force.

f. Must not close to prevent the insertion of the wire after the tube has been kinked and straightened out, or flattened.

g. Must not soften injuriously, or cause the wire to stick within the tube when subjected to a temperature of 150° Fahr.

Rule 51*k*. Amend first fine print note by striking out the first two words "on switchboards" and inserting in place thereof the words "for 100 ampere switches and larger."

In the third line of the same note strike out the words "on switchboards."

Change the last fine print note to read as follows:

"For three-wire Edison systems the separations and break distances for plain three-pole knife switches must not be less than those required in the above table for switches designed for the voltage between the neutral and outside wires."

Rule 54 A. New Rule—Rosettes.

Ceiling rosettes, both fused and fuseless, must be constructed in accordance with the following specifications:

a. **Base**—Current-carrying parts must be mounted on non-combustible, non-absorptive insulating bases. There should be no openings through the rosette base except those for the supporting screws and in the concealed type for the conductors also, and these openings should not be made any larger than necessary.

There must be at least 1/4" space, measured over the surface, between supporting screws and current-carrying parts. The supporting screws

PITTSBURGH
TYPE K TRANSFORMER

TO MAKE MONEY

—and make every cent there is in it—you must generate Current and distribute it with the smallest possible waste. PITTSBURGH TRANSFORMERS help you do this. If you are not using them, let us tell you about them.

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Central Electric Company

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Muralt & Co.
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Sterling Electric Co.
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Holtzer-Cabot Elec. Co.
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Manhattan Elec'l Supply Co.
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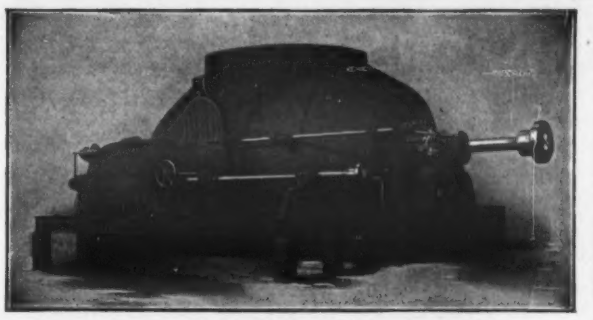

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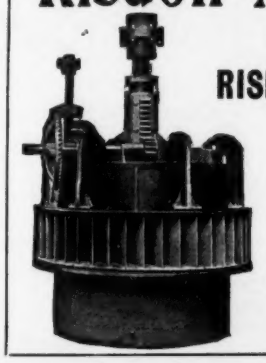

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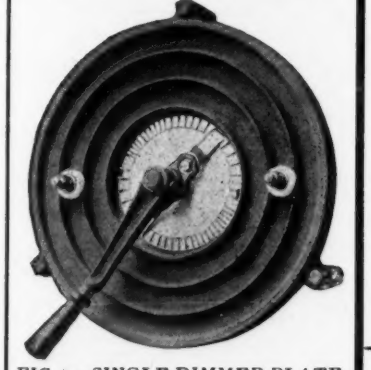

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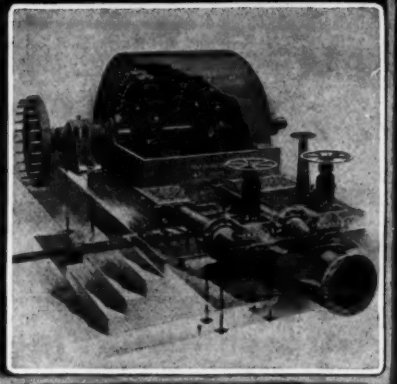

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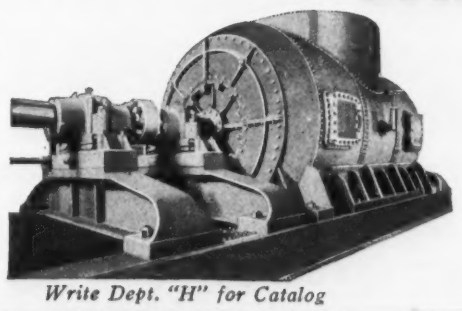

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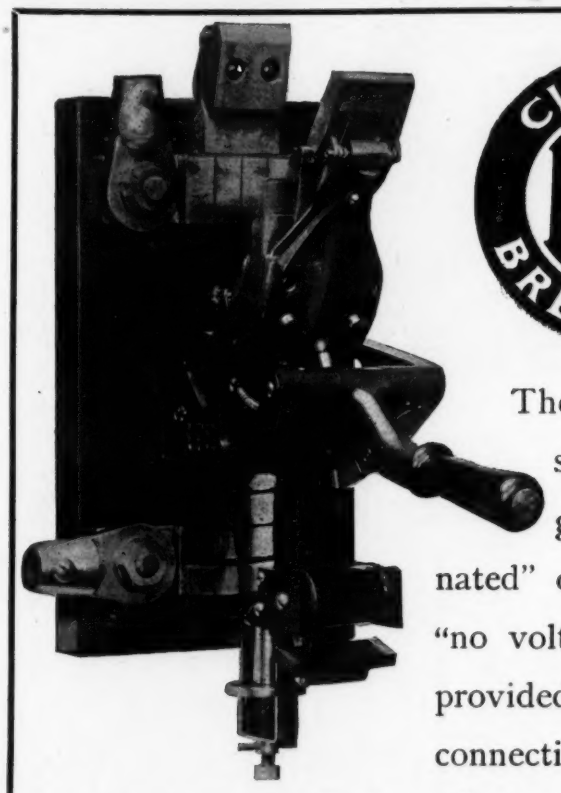

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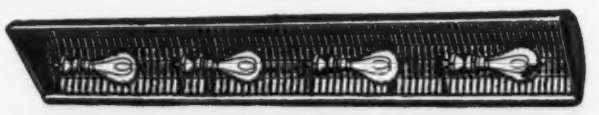

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